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The opening of the Chilian Exposition has been postponed until September, 1894, writes Mr. Frederick A. Bulen, Consul-General of Chili in New York. The purpose of this delay is to give more time to exhibitors in gathering their proposed exhibits.

A cave-in of the Wickes tunnel on the Great Northern Ry. occurred Nov. 17, which will take about six weeks to repair. It is about 22 ft. long and is located near the center of the tunnel. This cave-in follows closely a similar accident in the Mullan tunnel of the Northern Pacific R. R., which delayed traffic for 17 days.

The sanitary trustees of Chicago have recently straightened the Des Plaines River and built a levee for the purpose of excluding floods in that river from overflowing into the Chicago River and thus polluting or threatening the water supply from Lake Michigan. It is stated that the Des Plaines River will not now overflow into the Chicago River until its flow reaches 250,000 cu. ft. per minute, whereas formerly the overflow took place at 50,000 cu. ft. per minute.

Much needed harbor improvements are contemplated at Tacoma, Wash., and plans have been prepared by Frank C. Ross and D. B. Ogden and presented to the State Board at Olympia. The plans contemplate union terminals for the Great Northern, Northern Pacific, Union Pacific, Southern Pacific and Canadian Pacific railways. One interested in the plans is reported as stating as follows: At the present time the water front of Tacoma is inaccessible either by railway or wagon way only by passing over the tracks and property of the Northern Pacific R. R. Co., and by the present line to Portland a steep grade makes the hauling of freight from the wharf difficult and expensive. The new lines have low grades, less than 1%, and will shorten the distance between Seattle and Portland by several miles, as well as avoid the heavy grades. The plan submitted provides for three waterways, the west channel located as at present, the Puyallup River for the middle channel and the east channel along the east side of the bay. The railway terminal grounds will be on the Puyallup channel, near Commencement Bay addition. The waterways and slips will give ample room for the commerce of Tacoma, even if it becomes the Liverpool of the Pacific coast, as some of its advocates confidently prophesy. The wharf line will altogether make about 30 miles.

The protected cruiser "Olympia," built by the Union Iron Works, of San Francisco, Cal., made on Nov. 24 an official average trial speed record of 22.2 knots over the first 43 knots of her course. The breaking of a small bolt in her feed pump on her return makes another trial necessary. The "Olympia" is 5,000 tons displacement, with 13,500 HP., and the contract speed was 20 knots per hour. The official speed of the "Columbia," in her late trial, off Boston, has now been figured at 22.8 knots.

It is now proposed that the Chicago South Park Commissioners shall take possession of Jackson Park and all the Exposition buildings in it on Jan. 1, together with a sum of money, to be agreed upon, in full settlement of the Commission claims against the Exposition management. The buildings are to remain and be cared for by the commissioners as long as they see fit. What use the buildings are to be put to is not stated, but the general opinion seems to be that there is no salvage, or profit, in removing them.

Railway construction in Brazil is being encouraged by the government, and proposals have been invited in England for the carrying out and construction of a system of railway communication in the state of Bahia, Brazil. Particulars may be had on application to the Brazilian Consulate, 6 Great Winchester St., London, England.

Ventilation of passenger cars is being investigated by a committee of the Master Car Builders' Association, which will report at the convention next June. Mr. R. P. C. Sanderson, Division Superintendent of Motive Power of the Norfolk & Western Ry., Roanoke, Va., is chairman of the committee, to whom communications on the subject may be sent.

The most serious railway accident of the week was the derailment of a freight car on the Baltimore & Ohio R. R. bridge near Hyndman, Pa., Nov. 27. The bridge gave way and 15 cars went into the creek. No particulars of the bridge are given. Seven men are reported buried in the creek.——A glancing collision occurred at Tipton, Mo., on the Missouri Pacific Ry., Nov. 21, owing to the engineman of a freight train trying to back his engine and one coal car across the main track on to another side track in front of a fast mail train, for which he was waiting. The coal car was smashed and the engine of the express turned round and thrown on its side. Four men were injured, two fatally.

The repair shops of the Chicago & Grand Trunk Ry., at Forty-ninth and Johnson Sts., Chicago, were burned Nov. 20. The main building was of wood, two stories high, covering nearly half a block. The paint and blacksmith shops and several freight cars were also destroyed. The loss is estimated at $50,000.

A flying machine is to be built by the Austrian Society of Engineers and Architects after designs by Prof. Wellner, two other professors having reported that it is likely to be successful.

The cracking of back tube sheets on locomotives is being investigated by a committee of the Master Mechanics' Association. Any one having experience or information on this subject should communicate with Mr. L. R. Pomeroy, 29 Broadway, New York city. Another committee of the association, of which Mr. Godfrey W. Rhodes, Supt. of Motive Power of the Chicago, Burlington & Quincy R. R., is chairman, is investigating the cost of locomotive maintenance.

The Danube-Elbe canal project, says the London "Transport," is taking more definite shape. The proposed canal would be 60 ft. wide at the top, from 6½ to 30 ft. deep, with locks 223.7 ft. long and 26.24 ft. wide. The estimated cost is 80,000,000 florins, and the canal would permit the passage of boats of 500 tons. The canal would leave the Danube at Kornnenburg, near Vienna, and pass northwest 133 miles toward Budweis; from Budweis to Aupsig the rivers Moldau and Elbe would be canalized for 189½ miles. The difference in level is about 1,312 ft., starting at Kornnenburg, at an elevation of 515 ft. above sea-level. But the engineers now expect to use locks of 5 m., or 16.4 ft. lift, at least, instead of the 3 m. lift originally proposed. An abundant rainfall in the upper basin is depended upon to assure the requisite water supply. Another canal, starting at Vienna and penetrating the valley of the Oder as far as Schonbrunn, is also being pushed at Vienna by M. Paslin, a French engineer. This plan calls for a canal 164.4 miles long without branches, and the estimated cost is 73,000,000 florins. The line would be a prolongation of the Danube-Oder canal to Vienna, and would open up water communication with great industrial and colliery centers.

Electric towage has been in use on the Bourgogne Canal, in France, for about two months. This canal is on the summit connecting the canals of the Seine and the Saone systems. It is about 20,000 ft. long and over one-half of this distance is in a narrow, low tunnel just large enough for the passage of one boat, which was propelled by pulling on a chain fixed to the roof. The engineer, M. Galliet, utilized a fall of about 26 ft. at the ends of this canal to operate a hydraulic motor of 15 to 20 HP., and thus produced his electrical current. Upon the towing boat was then placed an electric motor taking current by a trolley pole from an overhead copper wire and operating the deck-pulley over which passed a chain lying on the bottom of the canal, after the usual French system of towing. This pulley had formerly been worked by a steam engine, and M. Galliot expects an economy of 30% as a result of the substitution of the electric current.

The Wentworth Ave. (Chicago) sewer, contracts for constructing which have recently been awarded to Messrs. Wilson & Jackson, Times Building, Chicago, as announced last week, will have a maximum internal diameter of 10½ ft. Mr. W. L. Stebbings, Monadnock Block, Chicago, consulting engineer to the contractors, proposes laying a track in the bottom of the sewer, on which tram cars will be run for carrying materials for construction. For lowering materials, a large manhole is to be built, in which a large elevator is to be run, the floor line of which will be on a level with the tracks; the cars can then be run directly from the elevator on to the tracks. Messrs. Wilson & Jackson's contract includes excavating 300,000 cu. yds. of earth, and 13,000,000 bricks will be required. The contract price was $394,080. Work is to be prosecuted day and night until completed.

The safety of travel on English railways was shown by Mr. J. Wolfe Barry in a recent presidential address to the Junior Engineering Society, England, to be steadily improving, and largely as an effect of the official inspectors of the Board of Trade in hastening the adoption of the block system and interlocking signals. For several years the companies did not realize that these improvements were in their interests, not only by diminishing accidents and consequent compensation, but also by greatly increasing the carrying capacity of their lines. Mr. Barry estimates that on the principal railways not a third of the present traffic could be handled without these improvements. The casualties per annum averaged for the years 1874, 1875, 1876 and 1890, 1891, 1892 were given as follows, the number of employees in 1892 being 381,000:

	Passengers.				Employees.			
	Killed.		Injured.		Killed.		Injured.	
	No.	1 in	No.	1 in	No.	1 in	No.	1 in
1874–76...	47	10,000,000	1,368	370,000	742	347	3,007	86
1890–92...	15	56,000,000	657	1,280,000	527	723	3,066	127

The air-brake patent decision in the suit of the Westinghouse Co. Vs. The New York Co. has been appealed to the court of last resort by the defendants, and a decision will probably be reached there within six months. Meanwhile the attorneys of the New York Co. have moved to vacate the injunction, pending the result in the Court of Appeals, preventing them from the further manufacture and sale of infringing apparatus, as announced last week. The motion was argued before Judge Townsend on Nov. 24. Mr. Maynadier, for the New York Co., said that his clients had about 3,000 car equipments at the Watertown works, completed or in process of construction, on which infringement was acknowledged. He asked the Court to permit the sale of these on payment of a sum to the Westinghouse Co. sufficient to cover the profits of which it would be deprived by such sale. He urged that as the patents sustained covered only the quick-action feature of the triple valve, it was a hardship to the defendants to have the sale of all other parts of the car equipment made practically impossible.

Mr. Betts, for the Westinghouse Co., said that the New York Co. had pursued all its infringement with the full knowledge of the Westinghouse Co.'s rights under its patents. If it had shown proper caution and consideration the Court's verdict would not have found it with 3,000 infringing brake equipments on its hands. The vacation of the injunction was not a necessity to relieve the New York Co. from any irreparable loss, for if the injunction were not vacated it could store these 3,000 infringing equipments for the few months until the Court of Appeals gives its decision, and should the decision be in its favor it could then market them. He presented affidavits from Geo. Westinghouse, Jr., H. H. Westinghouse and Messrs. Gray, Evans and Park, New York representatives of the company, setting forth the great damage that had resulted to the business of the Westinghouse Co. by the New York Co.'s infringement, and which would continue to accrue if further infringement were permitted. As bearing on the New York Co.'s plea that the injunction would work great injury thereto, he presented a circular letter which the New York Co. has sent out to its patrons since the decision was announced, claiming that the scope of the decision was so narrow that with only slight and unimportant changes in construction it could still market quick-action triple valves, and that the decision would have no material effect upon it. This public statement by the New York Co.'s officers, he contended, should be a sufficient disproof of the claim that it would suffer great injury were the injunction not vacated. Judge Townsend reserved his decision.

WATER PURIFICATION IN AMERICA.

(Continued from p. 98.)

The Latest Results with Sand Filter Beds at the Lawrence Experiment Station.

It is safe to say that there has been far more progress made in the purification of American water supplies in the past ten years than in the 52 years from 1831 to 1883, at the beginning of which the first recorded attempt at water purification in America was made at Richmond, Va. * The method employed at Richmond was upward filtration through small beds of gravel, and the object was the removal of suspended clay carried by the James River.

Since 1883 the mechanical or commercial filter has been developed with such success that it is now used in connection with the water supplies of 80 or more American cities, and since 1887 the experimental work of the Massachusetts State Board of Health at Lawrence has added largely to the world's knowledge of the laws of filtration.

In our issue of Aug. 3, 1893, on introducing this series of articles, the present status of water purification in this country was outlined and reference was made to the work at Lawrence. The latest available information regarding this work is now given below.**

In the purification of water by sand filtration the results depend largely upon the character of the sand employed, the most important factors being: (1) The size and (2) the uniformity of the sand grains, upon which depend (3) the open spaces or voids in the sand which regulate (4) the water and (5) the air capacity of the material and all of which have their effect upon (6) the loss of head or frictional resistance to water, and determine (7) the velocity with which water may pass the filter, and finally both the quantity and quality of a given water which may be secured by using a certain sand.

The Study of Sands.—The following information regarding the mechanical analysis and the study of sands is abstracted from the Report of the Massachusetts State Board of Health for 1892, the original matter having been prepared by Mr. Allen Hazen, Chemist of the Lawrence experiment station:

To separate sand, which should be without moisture, into different sizes, brass wire sieves are used, a series having 2, 4, 6, 10, 20, 40, 70, 100, 140 and 240 meshes to an inch being convenient; finally all the particles passing through the last sieve are first heated to ignite the organic matter, the amount of which is recorded, then subjected to elutriation, a process of washing out the finer particles by shaking with water in a beaker and decanting the water before any but the coarser particles have had time to settle. The sieves may be shaken by hand, or, for convenience and to save time, a mechanical shaker may be used.

Owing to variations in the patterns of various sized sieves, the mesh is not depended on for the size of the grains, so actual measurements are made of the material left on each sieve. The diameters of the coarser particles are calculated from their weight and specific gravity, and those of the smaller by actual micrometer measurements.

The total weight of each grade is taken and a curve is plotted from which the percentage of sand finer than any given size can be read. The finest 10% of the sand has been found to measure quite closely the work which it can do, and therefore the effective size of the sand is taken at the 10% line and the sand is described as one having 10% of its particles finer than a given size. The ratio between the diameter of the sand at the 60 and 10% points of the above line is called the uniformity coefficient. Low uniformity coefficients are of course desirable.

To find the open space the specific gravity of the sand, after drying, as a whole, is divided by that of the solid particles alone, and the quotient deducted from one; or a rough estimate may be made from the uniformity coefficient. Sharp grained sands with a coefficient less than two, as ordinarily packed, have coefficients of about 45%, and with a coefficient less than three, when packed in banks or settled in water, usually have a capacity of 40%. With coefficients of 6 to 8 the open space is only 30%. From 2 to 5% should be deducted from the above figures for round grained sands.

The quantity of water in sand is determined by drying a weighed portion and multiplying the specific gravity of the dried material as a whole by the ratio between the weight of water expelled by drying and that of the original material. The difference between the open space and volume of water is approximately the air space.

Capillarity is determined by finding the volume of water at different depths in a sand bed which has previously been saturated with water. The height at which water is held by capillarity is independent of temperature.

Frictional resistance is ascertained by determining the loss of head under different rates of filtration at two fixed points, for which purpose vertical glass tubes connecting with the points are used and the height of water in each observed. It is known that within certain limits the frictional resistance of sand to water varies directly as the rate of flow and depth of sand. In addition Mr. Hazen has found that the resistance varies inversely as the square of the effective size of the sand grain and quite widely with the temperature of the water. The following figures show the relative amounts of water at different temperatures which will pass coarse or fine sand:

Degrees C........ ...	0	5	10	15	20	25	30
Degrees F.............	32	41	50	59	68	77	86
Quantities.............	.70	.85	1.00	1.15	1.30	1.45	1.60

From all the data at hand Mr. Hazen presents the following formula for velocity, which applies only to sands with a uniformity coefficient below five and an effective size of 0.1 to 0.3 mm., or 0.004 to 0.012 in.:

$$V = c\, d^2 \frac{h}{l} (.70 + .03\, t\text{, where}$$

V = velocity in meters (39.37 ins.) daily in a solid column of the same area as that of the sand.

c = a constant factor which present experiments indicate to be approximately 1,000.

d = the effective size of the sand grain.

h = loss of head.

l = thickness of sand through which water passes.

t = temperature on centigrade scale, for which $\frac{t \text{ Fahr.} + 10}{60}$ may be substituted.

Regarding volume of filtration, Mr. Hazen states:

> The quantity of water which will filter through a sand when its pores are completely filled with water and in the entire absence of clogging, with an active head equal to the depth of sand, and a temperature of 10° C. (50° F.), forms an extremely convenient basis for calculation, and for convenience is called the maximum rate, as it is approximately equal to the greatest quantity of water which can be made to pass the sand under ordinary working conditions.

The formula and statements given just above are intended for use in studying different sands with a view of determining their suitability for filtering material. In estimating the working capacity of a filter reliance can be had only upon actual results from known materials.

Size of Sand in Actual Use at Various Places.—Analyses of some materials used for the experiments at Lawrence and in the actual filtration of water and sewage at different places show the following effective sizes and uniformity coefficients of the sand employed:

Use and location of filter.	Effective size, 10% finer than		Uniformity coefficient.
	mm.	in.	
Experimental, No. 1, Lawrence	.48	.019	2.4
" No. 9, "	.18	.007	2.0
" No. 2, "	.08	.003	2.0
Sewage, Gardner, Mass	.10-.24	.004-.009	6-14
" Marlboro, Mass .. .	.12	.005	3.4
" S. Framingh'm, Mass	.35-.42	.014-.017	4.5
City water, Lawrence, Mass..	.25-.30	.010-.012	2.5-4.5
" Birmingham, Eng.	.27	.011	1.8
" *London, Eng.....	.29	.011	2.0
" Poughkeepsie, N.Y.	.25-.35	.010-014	1.8-1.9

* Southwark & Vauxhall Co.

In discussing the size of sand, Mr. Hiram F. Mills, in the paper referred to in the second footnote to this article, says:

> Sands, the larger grains of the finer 10% of which are from .01 to 0.3 mm. (0.004 to 0.012 in.) in diameter, and whose capacity to pass water through a depth equal to the acting head ranges from 8,000,000 to 72,000,000 gallons per acre in 24 hours, have given excellent results when filtering 2,000,000 gallons per acre per day, and the mean of these sizes has also satisfactorily purified 3,000,000 gallons per acre per day.
>
> With still coarser sands, up to 0.5 mm. (0.019 in.) in diameter, good results have been obtained when filtering 1,000,000 gallons a day, but the results were variable, and the largest size mentioned has not given assurance that sewage polluted water can be constantly purified from its disease germs.

Some of the conclusions regarding the results of the experimental work of 1892 may now be presented, the information again being drawn from advance sheets of the report already mentioned, the author in this case being Mr. Geo. W. Fuller, who is in charge of the biological work of the station. Regarding these conclusions, it may be remarked that as they are based on experiments in a comparatively new field, many of which will doubtless be repeated over and over, some of them, at least, should be taken as merely indicating probabilities. In filtering water on a large scale results under different conditions, which correspond as closely as do many of these, would be taken to indicate that one condition was about as good as another, or that the range of conditions was far too narrow; but as these experiments have been conducted with the utmost refinement, small differences in results are of more importance than they would be in actual practice. A few fundamental principles seem to be determined with certainty, which, with the actual experience obtained in filtration both here and abroad, will enable an engineer to design a filter bed with far more confidence as to the results than could have been done a few years ago. The bed once constructed, experiments on a practical scale, with those at Lawrence as a guide, may be made until the best possible results, as shown by the quality and quantity of the filtered water, are obtained.

Description of the Lawrence Experimental Filters.—Most of the experimental filters have been placed under cover, the material being inclosed in galvanized iron tanks generally about 6 ft. deep and 20 ins. in diameter, the latter giving a surface area of 1-20,000 acre. The bottom of each tank is provided with a faucet and is covered by a layer of stones about 1 × 2 ins. in size, then by successive layers of small stones diminishing to ⅜-in. gravel in a depth of 3½ ins. and finally 1½ ins. of coarse mortar sand, upon which rests the filtering material.

Water is admitted to each filter from a small reservoir attached to the side of the tank and provided with an overflow. In water carrying much matter in suspension, such an arrangement of overflow has a decided advantage, since the waste water can deposit none of its sediment on the filter bed.

Character of the Water Before Filtration.—It must be remembered that the results at Lawrence are based upon water from one source, being brought through a small pipe about 400 ft. long from the North Canal of the Essex Co., which is supplied from the Merrimac River. It is said that the water is substantially the same as the river water above Lawrence, which is now applied to the large city filter beds. The odor of the water is usually slight, as are its turbidity and sediment, except during the spring freshets and after heavy rains. The temperature of the water ranged from 36° to 38° in the four winter months, and from 66° to 74° in the four summer months. The chlorine ranged from 0.11 to 0.21 part per 100,000, the albuminoid ammonia from 0.0130 to 0.02, the free ammonia from 0.0028 to 0.0081, the nitrogen as nitrates from 0.097 to 0.174, and the nitrites from 0.001 to 0.003, being the former figure for nine months of the year, and the oxygen consumed from 0.30 to 0.53 part per 100,000 throughout the year. During the first five months of the year the water was brought through a 1-in. pipe in which there was an accumulation of rust and sediment which gradually reduced the bacteria, but from June to December, inclusive, the bacteria ranged from 4,300 to 13,250. The above figures are based on monthly averages of weekly analyses made in 1892.

Bacterial Purification Under Different Conditions.—In the case of water supplies suspected of having been polluted by sewage the object is, or should be, to remove bacteria, and at the same time such organic impurities as serve as food for these micro-organisms, since a water supply offensive to either the smell or sight by reason of sewage pollution could not for a moment be tolerated. The experiments show, as would be expected, that more bacteria passed the filters at high than at low rates of filtration, but in nine filters with rates varying from 500,000 to 3,000,000 gallons per acre, never more than 0.6% of the applied bacteria passed a filter. The best results at 500,000 gallons per acre daily was a removal of 99.999%, while at 2,000,000 gallons 99.998% were removed. Another filter removed 99.984% at 500,000 gallons and 99.45% at 3,000,000 gallons daily. The species of bacteria applied was the bacillus prodigiosus, selected because its mode of life in water is similar to the bacillus typhi abdominalis, the germ which causes typhoid fever.

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* See Eng. News, June 16, 1883, for a brief description of the Richmond filter plant and also for a review of attempts at filtration in this country up to the date named.

** From the Report of the Massachusetts State Board of Health for 1892, and a paper on the "Purification of Sewage and Water by Filtration," prepared for Mr. Hiram F. Mills for the International Engineering Congress of the World's Columbian Exposition.

The effect of the size of sand grains showed that in continuous filtration sands having an effective size of 0.2, 0.14 and 0.09 mm. (0.008, .006 and .004 in.), 99.87, 99.96 and 99.98%, respectively, of the applied bacteria were removed, the rate of filtration being 2,000,000 gallons per acre. The experiments on this point with intermittent filtration gave similar results.

Depths of material of 5, 2 and 1 ft. showed but little difference in results at rates of 500,000 and 2,000,000 gallons, and with 3,000,000 gallons 2 ft. of sand removed 99.69 and 1 ft. 99.47% of the applied bacteria. Layers of loam in sand of an effective size of 0.2 mm. (.008 in.) had little effect, while in coarser sands it had more, but the loam leads to clogging.

Scraping filters to remove clogged surface material increases the number of bacteria for the three succeeding as compared with the three preceding days, but the average for ten filters, some working at as high a rate as 3,000,000 gallons per day, showed only 0.23% more water bacteria and 0.07% more bacilli prodigiosus after than before scraping. An examination of sand removed from a filter showed 55% of water bacteria and 93% of baccilli prodigiosus in the upper ¼ in. of the sand, while 82% of the former and all of the latter found in the sand were in the upper 1 in.

As to the relative advantages of intermittent and continuous filtration, definite conclusions are not drawn by Mr. Fuller, owing to complications during the course of the experiments. For sewage intermittent filtration is essential to the best results, and Mr. Mills, author of the paper already referred to, believes the intermittent filtration of water to be preferable to the continuous process.

During the summer months an increase occurred in the number of water bacteria passing the experimental filters, being much less for the intermittent than for the continuous filters. It is even stated that in some filters the number of bacteria in the filtered was greater than that in the unfiltered water. After careful investigation it was decided that typhoid fever germs do not increase under summer conditions and that the hygienic value of filtration is not impaired by the growth during warm weather of a very few of the more hardy water bacteria. Many experiments with the typhoid fever bacillus indicate that it does not increase in numbers in water but decreases from day to day, the longest duration of its life being 24 days.

Chemical Purification Under Different Conditions.—By chemical purification in this connection is meant the removal of organic matter which would otherwise serve as a food supply for bacteria. With rates of filtration of from 500,000 to 3,000,000 gallons per acre daily the percentage of albuminoid ammonia removed showed no very marked increase as the rate advanced. The size of sand grain, in the finer sands, showed but little effect for either continuous or intermittent filtration. The deeper filters removed somewhat more albuminoid ammonia than the shallow ones, but not at all in proportion to the depth. As was the case with bacterial purification the experiments with continuous and intermittent filtration were not considered extensive enough to warrant definite conclusions.

Removal of Color from Merrimac River Water.—New sand has been found more efficient than old, and deep beds more efficient than shallow in removing color, while rates of filtration, sizes of sand grains and thin layers of loam have exerted no great influence.

General Conclusions Regarding the Scraping of Filters.—One of the principal items of expense in operating a sand filter bed is the removal of the clogged material at the surface and its final renewal, either by washing the old or obtaining entirely new material. The results of 42 scrapings indicate that the average depth of clogged material to be removed is about ¼ in., fine sand requiring more frequent scraping than coarse, shallow filters more than deep and intermittent more than continuous ones.

RAILWAY STATION AT STOCKBRIDGE, MASS.

(With inset.)

The plan of the new railway station at Stockbridge, Mass., given this week, will be apt to commend itself both for intrinsic merit of design and adaptation to the special purposes of a station at this fashionable summer resort. The old station was struck by lightning and burned down in the summer of 1892 and a fund of about $2,000 was raised among the residents to substitute a stone station for the old wooden structure, that would otherwise have probably been rebuilt. The station grounds and those immediately surrounding are taken care of by the Laurel Hill Association, and their condition bears evidence of the strong local pride and complete organization marking the conduct of affairs at Stockbridge.

The station was built of a light colored stone, because of wide, overhanging eaves. The masonry is rubble ashlar, with red mortar joints, and the base course, buttresses, seats and borders around the flower beds are field stones, or rough boulders, with lichens left upon them. The outside woodwork is oiled and finished with spar varnish; the eaves are painted; the roof is made of slate.

The reveals of the doors and windows are nearly the full depth of the wall. The rafters over the ladies' room run to a center post under the peak and are there mortised and held together by a single black iron ornament with arms running out to each rafter. The clerestory comes above all this, the rafters supporting the outer roof showing overhead. The interior of the octagonal ladies' room has been arranged for a ceiling of hard pine, made as simple as possible.

All heating arrangements are in the basement and access to them is obtained by trap doors in the baggage-room. The heating is done by steam, led under the seats and elsewhere as desired. Outside there is shedroom for four to six carriages. The architect was Mr. Frank Waller, of 52 Broadway, New York.

THE NEW CUNARD STEAMERS "CAMPANIA" AND "LUCANIA."

The present year has seen two notable additions to the large fleet of transatlantic steamers, in the "Campania" and "Lucania," of the Cunard Line, which exceed in size the "New York" and "Paris," of the American Line, and the "Majestic" and "Teutonic," of the White Star Line. The "Campania" made her first trip in April, and the "Lucania" in September. These vessels hold the record for westward and eastward passages, the "Lucania" passing Sandy Hook on Nov. 4 with a record of 5 d. 12 h. 54 m., and the "Campania" arriving at Queenstown on Nov. 3 with a record of 5 d. 12 h. 7 m. The daily runs of these two trips are given in the following table, for which, as well as the accompanying photograph of the "Campania," we are indebted to Vernon H. Brown & Co., New York agents of the Cunard Line:

"Campania;" Eastward.
Sandy Hook Lightship,
9:10 A. M.,

Oct. 28 to noon....	47 knots
Oct. 29..	491 "
Oct. 30............	490 "
Oct. 31............	491 "
Nov. 1.............	505 "
Nov. 2	495 "
To 1:52 A. M., Nov. 3, at Dts. Rock..	293 "
Total...	2,812 knots

Equal to 21.28 knots per hour on passage 5 d. 12 h. 7 m.

"Lucania;" Westward.
Daunt's Rock. 12:55 P. M.,
Oct. 29 to

Noon Oct. 30... ..	481 knots
Oct. 31............	542 "
Nov. 1............	536 "
Nov. 2.......	490 "
Nov. 3............	535 "
To 9·7 P.M., Nov. 3	196 "
At S'dy H'k L'ts'p	—
Total...........	2,780 knots

Equal to 20.93 knots per hour on passage 5 d. 12 h. 47 m.

These interesting vessels are of enormous size, and are interesting both in regard to their structural design and their motive power, and they undoubtedly lead the list of celebrated Atlantic liners, although it is thought that in point of speed at least they may be surpassed by the new steamers for the American Line now being built by Cramps, of Philadelphia.

The two Cunard steamers were built by the Fairfield Shipbuilding & Engineering Co., of Scotland, which has built many of the Cunard steamers, and they represent an expenditure of about $6,250,000. They are designed to carry 600 first-class, 400 second-class and 700 to 1,000 third-class passengers. The proportion of beam to length is unusually great, being 9.23, as against 9.82 for the "Teutonic," of the White Star Line, and 8.37 for the "Paris," of the American Line. The general dimensions of the "Campania" and "Lucania" are as follows:

Length over all........................	622 ft. 0 ins.
Length between perpendiculars....	600 " 0 "
Beam, extreme	65 " 3 "
Depth from upper deck.....	41 " 6 "
Depth from shade deck......................	59 " 6 "
Tonnage........................	13,000 tons
Engines, I. H. P. on sea trial...............	31,050 HP.
Speed on sea trial........................	23.18 knots
Passengers, 1st class.....	600
" 2d class............................	400
" 3d class....	700 to 1,000
Officers and crew......................	415
Freight....................................... ...	1,620 tons

The following table of five of the Cunard steamers shows the growth of the Atlantic liners:

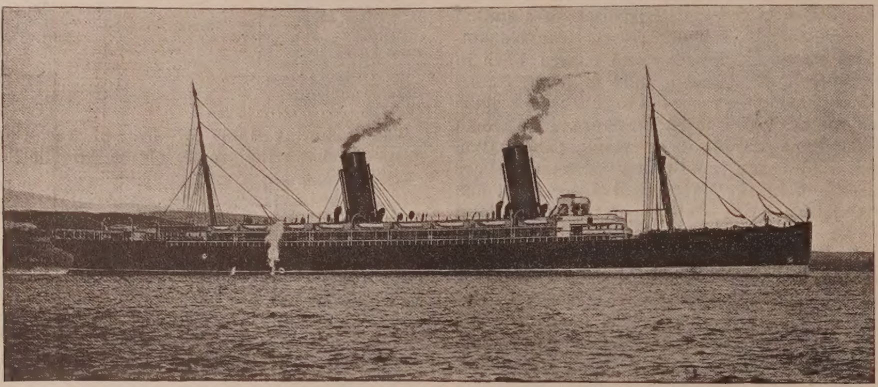
	"Britannia." 1840.	"Persia" 1856.	"Gallia" 1879.*	"Umbria." 1884.	"Campania." 1893.
Coal cons'ption, Liv'rpo'l to N'w York, tons	570	1,400	836	1,900	2,900
Freight, tons	224	750	1,700	1,000	1,620
No. of pass.	115	250	320	1,225	1,700
Ind. H. P...	710	3,600	5,000	14,500	30,000
Pres're, lbs.	9	33	75	110	165
Coal per I. H. P......	5.1	3.8	1.9	1.9	1.5
Speed, knots	8.5	13 1	15.5	19.0	22.0
Coal burned per ton car'd, tons	2.4	2.0	0.5	2.0	2.0
Coal burned per cabin pass., tons	4.7	5.1	....	3 8	2.75
Length of voyage, days.......	14	10	8	6	5.5

* The "Gallia" was built with large freight capacity while the "Umbria" and "Etruria," and the "Campania" and "Lucania" are specially for passenger traffic and carry only a limited amount of freight.

The "Campania" and "Lucania" are sister ships, and the following description applies to both vessels. The keel is entirely internal, with a web 4 ft. 6 ins. deep, and top and bottom chords of heavy angle irons. The flat keel plate is 4 ft. 6 ins. wide and 1 in. thick, with a ⅞-in. plate on the upper side, these plates being riveted to the bottom chord of the internal keel. Under the engines the keel is 8 ft. deep, and carries the engine base framing. Four girders of similar construction to the keel (two on each side of the keel) support the floor and carry the plating of the double bottom. All the riveting of this part of the work was done by hydraulic machines, and the angle irons are welded so as to form continuous frames. The vertical frames are of channel irons, 30 ins. apart, and start from the outer longitudinal girders, at the end of the double bottom, and this framing is further stiffened by plate frames 2 ft. to 3 ft. wide, placed at intervals and connected by double angles to the deckbeams. The beams are of bulb section, of unusual size. The shell plates are ¾ to 1 in. thick, and their minimum size is 25 ft. long by 6 ft. wide, while many of the plates are 8 ft. wide. The frames, plates and rivets are of steel, and enormous steel castings form the stem, sternpost, propeller shaft brackets and rudder frame. There is no longitudinal bulkhead, except between the engine-rooms, but 13 transverse bulkheads divide the hull into watertight compartments, the maximum length being 65 ft. The bulkhead between the engine-room has doors at the lower platform. Doorways in the transverse bulkheads are dispensed with as far as possible below the upper deck, and the bulkheads are stiffened by channels instead of angle irons. The deck houses are of steel, well built into the main framing so as to reduce the working of the superstructure in heavy weather. The four principal decks are of steel, covered with 3-in. and 4-in. deck planking. The plating from the keel to the water line has scarfed joints, with quadruple riveting. Above the water line butt joints are used, with inside and outside straps.

The bottom is on the cellular system, for water ballast.

The after frames and shell plating are curved to form the stern tubes, which extend to the propeller brackets, and a similar arrangement is made to inclose the rudder head. The propellers are in the same transverse plane, and an aperture is left in the frame between them, behind the rudder. The rudder plate, made at the Krupp works, in Germany, is 22 ft. by 11 ft. 6 ins., and 1¼ in. thick. The plate weighs about ten tons, and the entire rudder about 24 tons. The cast steel rudder frames, stern posts, stem posts, etc., were made by the Steel Co. of Scotland. The first keel plate of the "Campania" was laid Sept. 22, 1891, and the vessel was launched Sept. 8, 1892. The "Lucania" was launched Feb. 2, 1893.


STEAMSHIP "CAMPANIA;" CUNARD LINE.

Each ship has twin screws, driven by engines of the marine, inverted cylinder, direct-acting type. The engines, designed and built at the Fairfield Works, are of the triple-expansion type. They have five cylinders (two high pressure, one intermediate and two low pressure), but the high pressure are placed above the low pressure, so that there are only three cranks. The cylinders are 37 ins. (two), 79 ins. (one) and 98 ins. (two) diameter, all of 69-ins. stroke. From the base of the engine bedplate to the top of cylinders is 47 ft. The bedplate is 5 ft. 6 ins. deep, of cast iron, bolted to the seating of the ship's framing, and the cylinders are braced by fore and aft stays. The cylinders have steam jackets fitted with automatic steam traps to return condensed water to the hot well. The valve gears are of the double eccentric, link motion type, with piston valves to the high pressure and slide valves to the intermediate and low pressure cylinders. The condenser is of rectangular section, fitted with ¾-in. brass tubes. The crosshead of the fore and after engines has a lever driving two air and circulating pumps. The circulating pump engines work compound with steam at high pressure, exhausting into the low-pressure steam chest or the condenser at the will of the engineer, and by a simple valve arrangement both cylinders can receive high pressure steam while pumping from the bilge. These pumps run at 100 revolutions per minute when circulating, and 250 revolutions when pumping from the bilge. Auxiliary condensers are provided for use when the main engines are at rest. The engines are fitted with the Brown emergency steam and hydraulic starting and reversing gear, by which the engines are stopped automatically if they exceed a given speed.

The crankshaft is 26 ins. diameter, and each of the three interchangeable parts weighs 27 tons, so that with the thrust shaft, 14 ft. long, the weight of each crankshaft is about 110 gross tons. The thrust bearings have 14 horseshoe rings. The propeller shafts are 24 ins. diameter, in lengths of 24 ft., each length having two bearings. The pillow blocks are of cast iron lined with white metal. The shafts are entirely inclosed in the stern tubes, having no outboard sections, and consequently no shaft struts at the stern. The bushing of the stern bearings is of brass, lined with lignum vitae, the shaft being sheathed at the bearing. The propeller boss is of steel and the three blades are of manganese bronze weighing eight tons each. Dunlop's governors are fitted to the after end of the propeller shaft. The shafting and bosses were made by Vickers & Co., of Sheffield. At the outer end of the stern tubes is a steel casting extending across the hull and built into the framing. This takes the place of the shaft brackets.

Each ship has twelve main boilers and two auxiliary boilers, the total number of furnaces being 102. The main boilers are of the double-end pattern, 18 ft. diameter and 17 ft. long, with four Fox corrugated furnaces at each end. One of the smaller boilers is 18 × 11 ft., with four furnaces, for the auxiliary machinery, and the other, 10 × 10 ft., with two furnaces, is for the donkey engines when the ship is in port, but all can be connected with the main steam pipe. The boilers are placed longitudinally, three in a row, and occupy two of the compartments, with another compartment, forming a coal bunker 65 ft. long, between them. There is a smokestack to each of the two batteries of boilers, the inside diameter being 20 ft. and the height from keel to top of smokestack 130 ft. The main boilers are of steel plates 1 17-32 in. thick and carry 165 lbs. working pressure. Forced draft is not used, but the stokeholds are open, and are ventilated by the usual ventilators and cowls, and by fans driven by Allen's triple-expansion single-crank engines. Weir pumps are fitted for boiler feed, auxiliary feed, fire and general purposes, and each ship has four Weir evaporators with a capacity of 30 tons of fresh water per day. The main steam pipes are of wrought iron with lap-welded joints; the largest are 20 ins. diameter and 9-16 in. thick. The boilers were all made at the Fairfield works.

The electric light plant, put in by Siemens Bros. & Co., of London, is very complete, including about 1,350 lights of 16 c. p. with about 50 miles of wire. There are several portable lights for the engine-rooms and portable eight-light groups for use at the freight hatches. The current is generated by four dynamos, each driven by a separate engine, and any two dynamos can supply all the lights. The engines are vertical, compound direct-acting, with cylinders 9½ × 10 ins. and 15 × 10 ins., designed for 70 brake HP. at 275 revs. per minute and with 100 lbs. pressure at the stop valve. The dynamos have drum armatures 15 ins. diameter, and have a capacity of 420 amperes under 100 volts pressure at 275 revolutions, and can thus run 700 lights of 16 c. p. The search-light is of 2,000 c. p., and can be fitted on the stem and lowered to the water's edge when the ship is working to her anchorage at night. The side lights have both oil and electricity, and the masthead light is also an electric lamp.

The steering gear is of Brown's patent, the engine being attached to the rudder head, without the intervention of chains or ropes. The main and auxiliary gear are both driven by steam, no hand gear being fitted, and the steering is effected by a small telemotor in the wheel house on the bridge. Another steering station is fitted on the poop, and a third is below the water line for use in the event of the ship being employed as a cruiser. The bridge is about 60 ft. above the water.

The finest staterooms are on the promenade and upper decks. The ordinary first and second-class staterooms are on the upper and main decks, the first-class being all forward and the second-class aft of the engines. The third-class passengers are quartered on the lower deck. The crew's quarters are in the forecastle, the navigating officers' quarters are in the shade deck, near the bridge, and those of the engineer officers are on the main deck, near the engines. The staterooms are ventilated on Uttley's system, and there are ventilating cowls for the stokeholds and forecastle. Steam heating is provided for. The dining saloon is 100 ft. long and 64 ft. wide, with accommodation for 430 persons.

The cold air chambers for the provision-rooms are fitted with the De la Vergne ammonia compression refrigerating plant, the cooling being effected by the circulation of cold lime. The compressor is vertical, single-acting, 4½ × 9 ins., driven by a high-pressure horizontal steam engine. The stores are below the kitchen, etc., and, for a full complement of passengers, include about 20,000 lbs. of fresh beef, 1,000 lbs. of corned beef, 10,000 lbs. of mutton, 1,400 lbs. of lamb, 500 lbs. of veal, 500 lbs. of pork, 3,500 lbs. of fresh fish, 10,000 fowls, 400 chickens, 150 ducks, 80 geese, 100 turkeys, 30 tons of potatoes, 30 hampers of vegetables, 300 quarts of ice cream, 1,600 quarts of milk, 18,000 eggs. 1,000 lbs. of tea, 1,500 lbs. of coffee, 2,800 lbs. of white sugar, 4,500 lbs. of moist sugar, 1,000 lbs. of pulverized sugar, 2,400 lbs. of cheese, 3,000 lbs. of butter, 6,000 lbs. of ham and 1,800 lbs. of bacon, etc.

There are five holds, each with hatchways and hoisting engines, and the space not required for mails and baggage will accommodate about 1,620 tons of freight. There are also three chambers for dead meat, a separate refrigerating plant being provided, working on the ammonia compression system. The chambers accommodate about 2,700 quarters of beef.

The crew and officers number 415 in all: 61 in the sailing department, 195 in the engineers' department, and 159 in the steward's department. Thus with a full complement of passengers there will be about 2,400 persons on board.

ROAD MACHINERY AT THE WORLD'S COLUMBIAN EXPOSITION.

The road and street exhibits at the Exposition were described in our issue of Nov. 9, and we now take up the exhibit of machinery for road construction and maintenance, which was a large and interesting one, though somewhat marred by the way in which the exhibits had been scattered through various departments. A large number of steam rollers, sprinklers, etc., were in use on the roadway, as shown by the following statement from Mr. R. Ulrich, Superintendent of Landscape, Road and Miscellaneous Department, regarding the machines used by the Kimbell & Cobb Stone Co. in the construction and maintenance of the roadways:

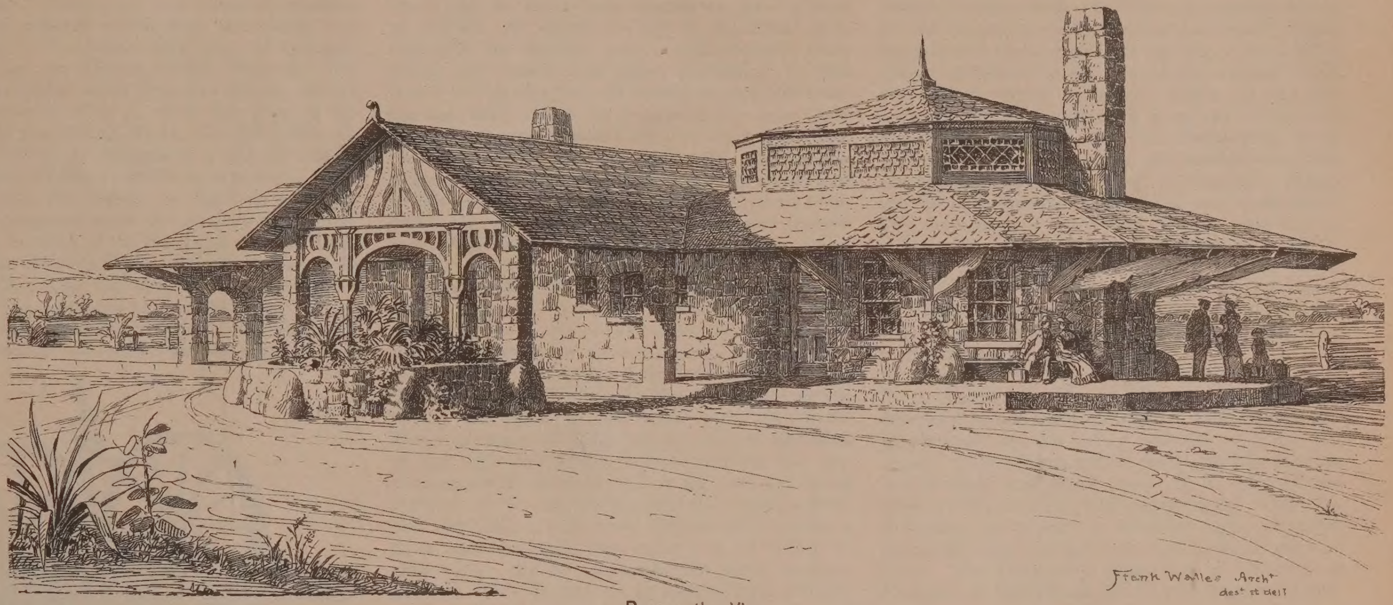
Steam Rollers:
- **1 Harrisburg Foundry & Machine Co............. 10 tons**
- **6 O. S. Kelly Co., 3 of 12 tons, 3 of..... .... 5 tons**
- **2 Pioneer Iron Works.............................2½ tons**

Street Sprinklers:
- **4 Studebaker Bros. Mfg. Co...2 four-wheel, 2 two-wheel**
- **5 Miller Knoblock Wagon Co...4 hor. tank, 1 vert. tank**
- **13 Winkler Bros. Mfg. Co., 8 hor. tank, 4 vert tank and 1 single hand sprinkler**

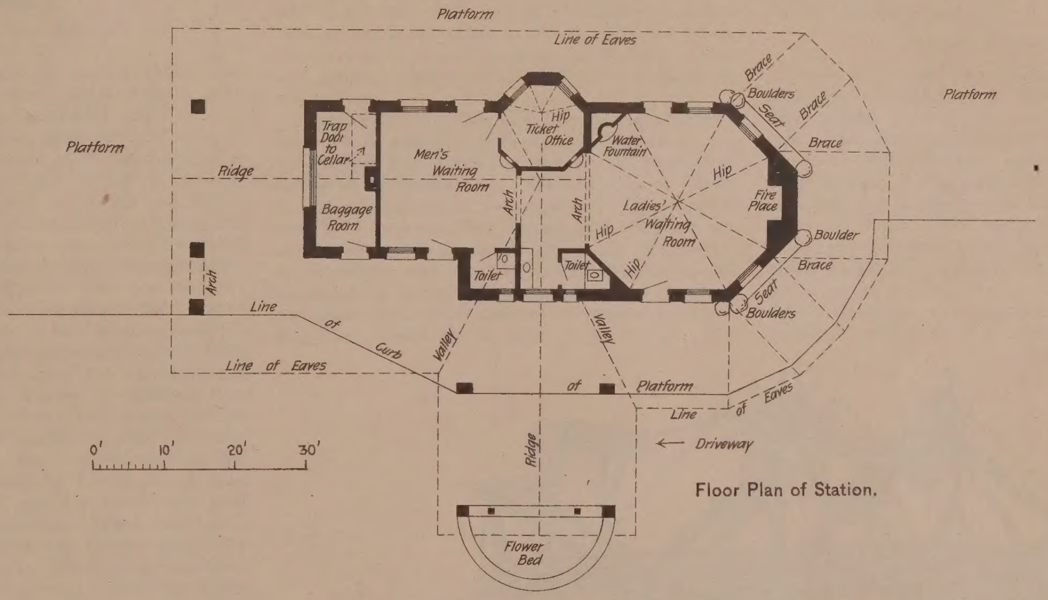
Street Sweepers:
- **3 F. Cartwright (Chapman-O'Neil machines).**
- **1 Edson Mfg. Co.**

Graders and Ditchers.

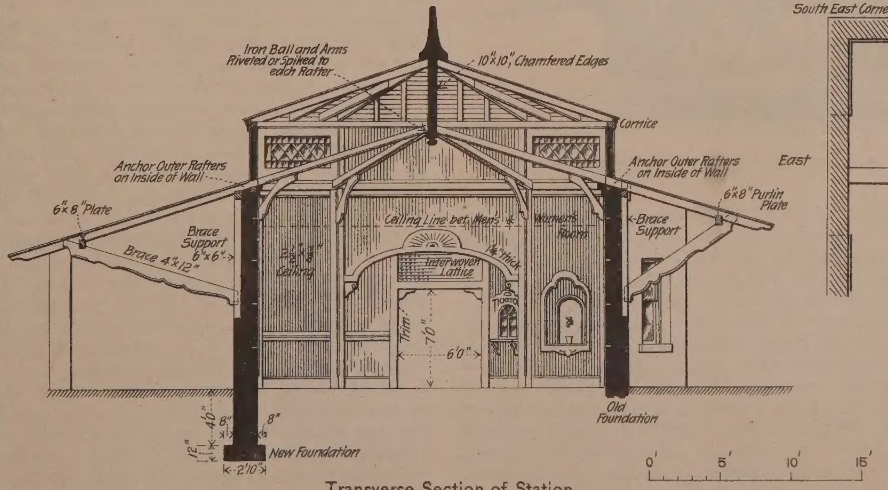
The use of grading machines or road machines in the construction and repair of country roads is now very general and is steadily increasing, the steady demand and consequent competition resulting in great improvements in the design and manufacture of these machines. Essentially a road machine consists of a frame carried on wheels and fitted with a long adjustable plow or scraper blade, the front end of which cuts a furrow in the soil, while the edge of the blade moves the material back and distributes it evenly to form a smooth road surface. The machine is hauled by teams and makes successive cuts, until the desired depth of cut and surface of road are obtained. Similar machines are used on railway grading, canal and ditch construction, etc. Where the earth is to be hauled to a distance from the excavation, a plow of different form is used, delivering the soil upon a wide inclined traveling belt which raises the soil and dumps it into wagons or to form a bank parallel with the excavation. Scrapers are large shovels



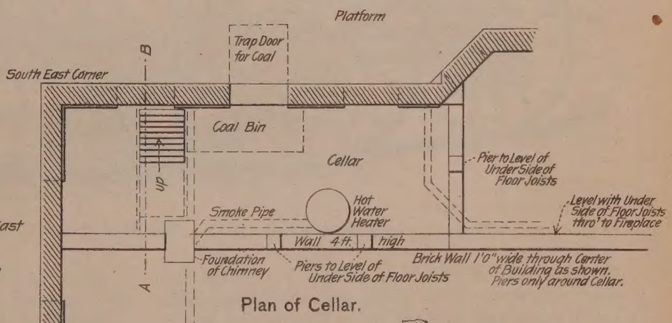
Perspective View.



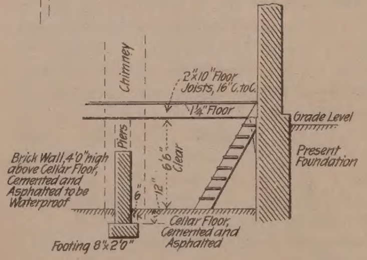
Floor Plan of Station.



Transverse Section of Station.


Platform
Trap Door for Coal
B
South East Corner
Coal Bin
Cellar
Pier to Level of Under Side of Floor Joists
up
Smoke Pipe
Hot Water Heater
Level with Under Side of Floor Joists thro' to Fireplace
East
Wall 4 ft. high
Foundation of Chimney
Piers to Level of Under Side of Floor Joists
Brick Wall 1'0" wide through Center of Building as shown. Piers only around Cellar.
A

Plan of Cellar.


Chimney
2"x10" Floor Joists, 16" C. to C.
1¼" Floor
Grade Level
Present Foundation
Piers
6'6" Clear
12"
6"
Brick Wall, 4'0" high above Cellar Floor, Cemented and Asphalted to be Waterproof
Cellar Floor, Cemented and Asphalted
Footing 8"x2'0"

Section A–B.

Station at Stockbridge, Mass., Housatonic Division; N. Y., N. H. & H. R. R.

FRANK WALLER, NEW YORK, ARCHITECT.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

or scoops, hauled by teams, and are either wheeled scrapers (Fig. 1) or drag scrapers, the latter having no wheels.

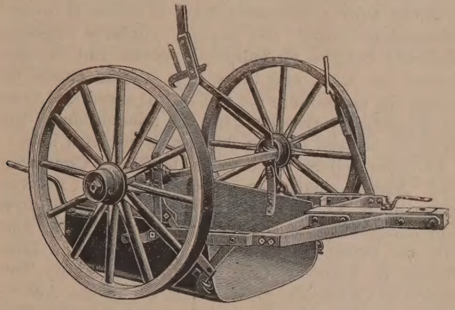


Fig. 1. Wheeled Scraper.

An extensive exhibit of this class of grading, ditching and general roadmaking machinery was that of the F. C. Austin Mfg. Co., of Chicago, which was in the Transportation Building. The company's specialty is the New Era grader, ditcher and wagon loader, Fig. 2, which has been in use for nearly 20 years (Eng. News, Nov. 15, 1889, and March 15, 1890). It consists of a strong trussed frame on four wheels, to which is attached a plow. The earth from the furrow is raised on the mold board and deposited upon the transverse carrying belt, which conveys it to the bank on the dump wagon. This carrier is built in four sections, to be bolted together, and will deliver at 14, 17, 19 or 22 ft. from the plow, and at a height of 8 ft. at the extreme length. The hand wheels for adjusting the plow, carrier and other working parts, to suit the requirements of the work, are all within easy reach of the operator, who stands upon a platform, from which he can command a full view of the work. The machine is operated by a force of three men and twelve horses. The makers guarantee the machine to place 1,000 cu. yds. in bank or to load 600 to 800 cu. yds. in wagons per day of ten hours, and the cost is estimated at 1½ to 2½ cts. per cu. yd. The above quantities are based on actual experience under average circumstances, and many larger amounts of work are reported. In railway work the machine should be followed with a harrow, and when a 6-ft. drag is used the entire roadbed receives six applications of the drag. As the earth is delivered from the machine in a continuous and regular stream, a roadbed thus harrowed will be more firmly and evenly packed than where the earth is dumped in piles by scrapers. This machine has been largely used in the construction of the Northern Pacific R. R. and other western railways, and for street and road grading, and other excavation. When used as a wagon loader the wagons are driven under the elevated end of the carrier. These machines have been sent to foreign countries, including South Africa and New Zealand, for railway and irrigation canal work. The Austin steel reversible road machine is said to be in use in nearly every state, by road commissioners and others, for making and repairing county roads, cleaning and widening ditches, spreading broken stone, etc. The steel frame is curved upward, and below it is the suspended frame carrying the scraper, a yoke from this frame being pivoted over the front axle.

The American Road Machine Co., of Kennett Square, Pa., exhibited its American Champion reversible road machine, which was originally designed for rough and rocky work in New England, but has been used in all kinds of materials. This machine has a reversible blade, so that the operator can easily and quickly change the blade for right or left action, while a special feature is the pitch adjustment, so that the blade can be tilted backward for plowing moist ground, or forward to set the proper inclination of the edge for penetrating hard clay, gumbo or stony soil. The various movements are effected by means of hand wheels. A shifting rear axle of adjustable length is used, so that while the front and rear wheels on one side may form a guide or landside against the edge of the cut, the other rear wheel can be extended beyond the reach of the blade and thus kept on the smooth surface already graded. Grading plows, drag and wheel scrapers and rock crushers are also manufactured by this company. The Western Wheeled Scraper Co., of Aurora, Ill., exhibited a well built machine made entirely of steel, but which can be fitted with wooden or steel wheels as desired. As shown in Fig. 3, the frame is a rectangle of channel steel, with riveted cross pieces, and stands well above the axles. To this frame are riveted the standards carrying the gearing and hand wheels for regulating the height and the vertical and horizontal angle of the scraper, and the length of the extensible rear axle. The scraper is hung from an iron circle between the axles, and to this circle are attached the lifting rods and the draft yoke, the front end of the yoke being pivoted just behind the front axle. The driver has a spring seat at the front end of the frame, and the plow operator stands on a platform at the rear of the frame, where all the hand wheels are assembled, and he can see the entire length of the scraper. The wheels track, or have the same gage, but the rear axle can be extended on either side so that the wheel on the delivering side is no obstruction to the discharge of the earth from the blade. These machines are intended for work in any kind of soil and over rough or even ground, and are adapted for ditching as well as for road and other grading. In the elevating grader and wagon loader, also exhibited, a side plow delivers the dirt on a wide traveling belt, the upper end of which is placed over the dirt wagons. The drag scrapers made by this company are of 3-16-in. steel and are of about ½ to ⅔ cu. yd. capacity. In the wheeled scrapers the box or scoop is hung below the axle. They are of 1 to 2 cu. yds. capacity and weigh 300 to 590 lbs. This method of hauling is recommended for hauls of 50 to 600 ft., and the scrapers are usually worked in gangs of 10 to 15. Road and railway grading plows and rock crushers are also made.

A simpler and rougher style of road machine than those above described, and intended largely for use by farmers and others for county road work, was exhibited by Montgomery Ward & Co., of Chicago. It is intended to be mounted on the running gear of a common farm wagon, and its parts are made heavy and strong for rough use. The blade is reversible and its height and inclination are regulated by levers. When raised it can be turned for either right or left delivery by means of a chain and hand wheel at the rear of the frame. The scraper blade has a strong bail in front, giving it a direct pull against the soil, and is pivoted to an upright shaft, so that either end can be raised or lowered by the levers, or the blade swung round to cut in either direction. The blade is 7 ft. long, made of crucible steel, and the lower edge is fitted with a knife of tempered steel, which can readily be detached for sharpening. The front part of the bed or frame is arched to allow the front wheels to run under in making a short turn. The machine weighs 1,500 lbs. and costs $100, independent of the trucks. Kilburne & Jacobs, of Columbus, O., exhibited different styles of their pressed steel drag scrapers and wheeled scrapers.

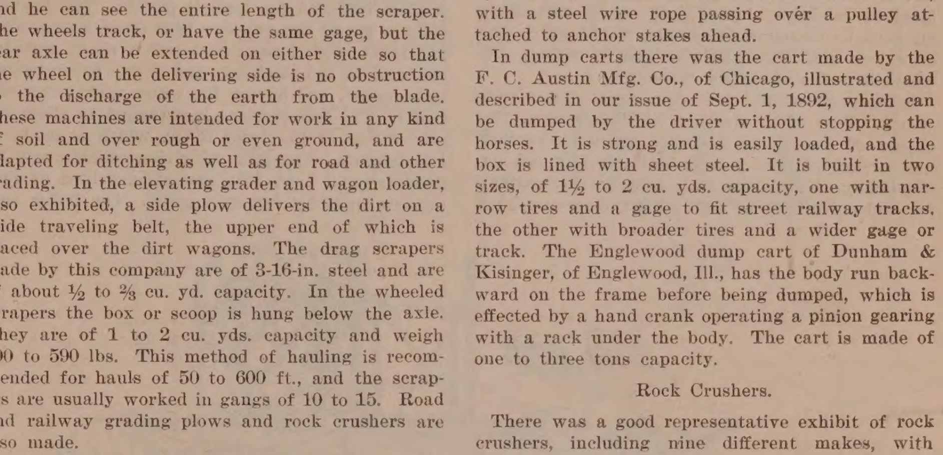


FIG. 2. "NEW ERA" GRADING MACHINE; F. C. Austin Mfg. Co., Chicago.

The Plumb ditching machine, for use with tile drainage, was exhibited by the American Well Works, of Aurora, Ill. It consists of a vertical boiler and horizontal engine and a circular cutting wheel, all mounted on a frame with four carrying wheels having tires 10 ins. wide. A link belt driven by the engine operates a small cog wheel which gears with a circular rack on the side of the cutting wheel. Attached to the rim of the cutting wheel are curved cutters or scoops, which cut the full depth of the ditch (giving it a curved bottom for the tile) and elevate the dirt, discharging it on one side of the ditch ready for refilling after the tile has been laid. The wheel is hung on a swinging frame so that the depth of cut can be regulated. The machine will cut a ditch 11 ins. wide and to a depth of 4 ft. at the rate of 1,600 to 2,500 ft. per day, and the cost is claimed to be only 30 to 55 cts. per 100 ft. The machine is moved forward by means of a drum on the front end of the frame, with a steel wire rope passing over a pulley attached to anchor stakes ahead.

In dump carts there was the cart made by the F. C. Austin Mfg. Co., of Chicago, illustrated and described in our issue of Sept. 1, 1892, which can be dumped by the driver without stopping the horses. It is strong and is easily loaded, and the box is lined with sheet steel. It is built in two sizes, of 1½ to 2 cu. yds. capacity, one with narrow tires and a gage to fit street railway tracks, the other with broader tires and a wider gage or track. The Englewood dump cart of Dunham & Kisinger, of Englewood, Ill., has the body run backward on the frame before being dumped, which is effected by a hand crank operating a pinion gearing with a rack under the body. The cart is made of one to three tons capacity.

Rock Crushers.

There was a good representative exhibit of rock crushers, including nine different makes, with three of the gyratory type and seven of the jaw type. The most prominent of the former was an enormous Gates crusher exhibited by the Gates Iron Works, of Chicago, which is their No. 7½ size, and has a capacity of 150 tons of macadam stone per hour. This machine, which was illustrated and described in our issue of Feb. 9, weighs about 60,000 lbs., and will break rocks of 14 × 30 ins. to a 2½-in. size. As in the other sizes of the Gates machines, the crushing is effected by the eccentric movement of a conical head on a vertical shaft in a conical or funnel-shaped chamber, the crusher and the lining of the chamber being of chilled cast iron. The shaft is fulcrumed at the top and the lower end revolves in a circular path by means of an eccentric driven by bevel gearing. The end of the shaft rests on an adjustable bearing, and the size of the output is regulated by raising or lowering the shaft and crushing head. The same makers also exhibited a small machine, and a model macadam or ballast plant, with crushing, elevating, screening and loading machinery. The National Machinery Co., of Tiffin, O., exhibited a vertical crusher of generally similar design to the above, but having a ribbed crushing head, while the shaft has its fulcrum in a bell and socket bearing below the crushing head, and the adjustment of size of product is effected by raising and lowering the lining of the chamber. The shaft is driven by bevel gearing at the bottom, but has no bottom bearing, being suspended from the ball and socket bearing, so that the eccentric socket on the gearing carries no weight. The machines are made in sizes having capacities of 6 to 70 tons of macadam stone per hour, while a small size is made with a capacity of 250 to 500 lbs. per hour. The third gyratory crusher, also of the vertical pattern, was that exhibited by R. McCully, of Philadelphia, which closely resembles the other two. The vertical shaft is suspended from a top bearing, and driven by bevel gearing at the bottom, the lower end of the shaft fitting into an eccentric hub. The top end of the shaft is threaded and has two nuts screwed upon it, the size of product being regulated by raising or lowering the shaft and crushing head by means of these nuts, one of which acts as a lock nut. The crushing head is conical, and works in a funnel-shaped chamber.

In crushers of the jaw type seven styles were shown. That of R. McCully, of Philadelphia, Pa., maker of the above described gyratory crusher, has corrugated jaws moving both laterally and longitudinally. This machine is intended for graulating and pulverizing as well as for heavy crushing. The F. C. Austin Mfg. Co. had a crusher which is mounted on heavy low trucks for ready transportation from place to place where a permanently located plant is not desired. In this crusher the jaws have a horizontal oscillatory motion, the dies being on the end of a lever having a horizontal throw. The American Road Machine Co. had in operation a Champion rock crusher, supplying the fine material for repairing the surface of the roadways, a bucket elevator carrying the product to a revolving screen overhead, from which the sorted sizes flow down chutes to the carts or bins. The frame is of steel, with removable dies of chilled iron, and journal boxes of phosphor-bronze for the shaft. The main shaft is of elliptical section, and thus one revolution of the flywheels produces two movements of the jaws. This shaft bears against an anti-friction roller journaled on the tumblers, thus reducing the wear. A portable form of this crusher was shown in our issue of March 9, 1893. The Western Wheeled Scraper Co. had a crusher in which the movable jaw is forced directly forward instead of with a swinging motion, and a double cam gives two strokes of the jaw to each revolution of the shaft. The No. 10 size has two 44-in. wheels, 8 ins. face, weighing 2,000 lbs. each, used as balance and belt wheels and making 175 revolutions per minute. The jaws will receive stone 9 × 15½ ins., and with 15 HP. will crush from 8 to 15 tons per hour, according to hardness of rock and size of product. The size of product is regulated by the use of different sizes of liners, the jaws being of chilled cast steel with corrugated faces. James H. Lancaster, of New York city, exhibited the Lancaster crusher, in which a double cam gives the stroke to the long end of the lever operating the movable jaw, which rocks upon two toggles, the jaw having, therefore, a downward and forward movement in crushing. The double cam gives two strokes for each revolution of the shaft, and bears upon a friction roller interposed between it and the lever. Fraser & Chalmers, of Chicago, exhibited the Dodge and Blake crushers, which were in use daily for crushing the diamond-bearing rock for the diamond washing exhibit of the De Beers Mining Co., of South Africa.

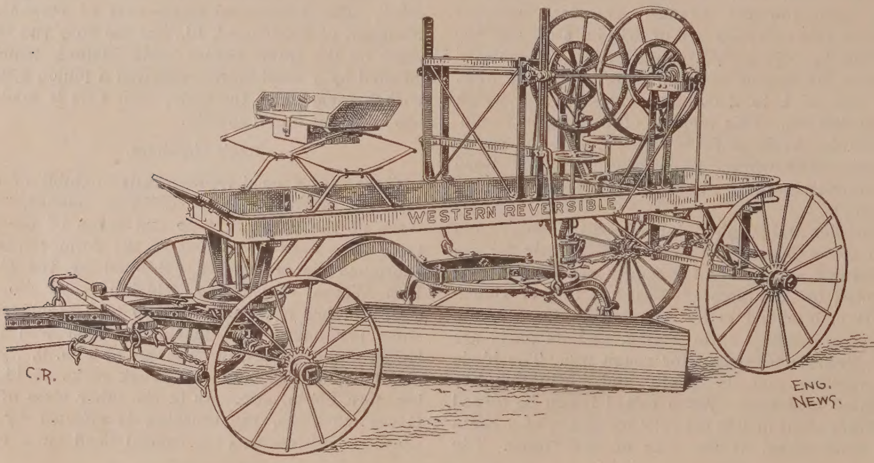


FIG. 3. ROAD MACHINE; Western Wheeled Scraper Co., Aurora, Ill.

Road Rollers.

There were four exhibitors of steam rollers and three of horse rollers, and several of the steam rollers were in use on the roadways. Some interesting particulars on steam rollers and their use were given in our issue of Nov. 10, 1892. The O. S. Kelly Co., of Springfield, O., had six steam rollers in regular use, of which three were rated as 10-ton engines (actual weight, 25,000 lbs.), and three were 5-ton engines intended for asphalt paving. The heavier engines are of the ordinary type (Eng. News, Nov. 21, 1891), with loco-tubular boiler, single cylinder mounted on the smokebox end of the boiler barrel, link motion, and having the water tank below the boiler. The fore-carriage is arranged to allow for side tilting of the front roller, which is made in two sections. The rear or driving rollers are 6 ft. diameter and 1 ft. 10½ ins. wide, driven at fast or slow speed by cut steel gears. The boiler barrel is of ⅜-in. steel. The smaller engines (Eng. News, Nov. 24, 1892) are similar to the Lindeloff type. Each has a vertical boiler, a low frame hung from the bearings of the main roller and having an upright front end carrying the pivot of the fore-carriage. The two cylinders, 6½ × 6 ins., are nearly vertical and drive a horizontal shaft with a bevel wheel gearing with a circular rack on the side of the main roller. The smaller or steering roller is 2 ft. 8 ins. diameter and the main roller 4 ft. diameter, both 3 ft. 4 ins. wide. The weight in working order is 11,000 lbs., which may be increased to 14,000 lbs. by loading the drum. The machine carries 80 gallons of water and 200 lbs. of coal, sufficient for four hours' service. The dimensions over all are 14 ft. long, 4 ft. 6 ins. wide and 7 ft. 3 ins. high. The Harrisburg Foundry & Machine Co., of Harrisburg, Pa., had a ten-ton steam roller which had been in use on the grounds since May, 1892. It was notable in having two cylinders, which is the general practice of this company. The two cylinders and their valve chests are made in one casting, with dome bolted to top of cylinders. The shafting is of open-hearth steel, with phosphor-bronze boxes. The boiler is of ⅜-in. and ½-in. steel. The tanks have a capacity of 125 gallons and the bunkers hold 400 lbs. of coal. The rear wheels are 16 ins. wide, and locking pins are provided so that one or both wheels can be locked to the main axle, one wheel being sufficient on level and good roads and enabling short turns to be made more easily. The Pioneer Iron Works, of Brooklyn, N. Y., had two small rollers of the Lindeloff type (Eng. News, Aug. 9, 1879, and Nov. 10 and 24, 1892) in service on the grounds. Each engine has a vertical boiler 21 ins. diameter and 5 ft. 9 ins. high, with 85 tubes 1¼ ins. diameter and 2 ft. ¾ in. long. There are two vertical cylinders, 4 × 5 ins., driving a shaft and bevel gear on the side of the main roller, which is 3 ft. diameter and 2 ft. 6 ins. wide, while the four steering rollers are 1 ft. 9 ins. diameter and 7½ ins. wide. The weight, with water in boiler and tank, is 3,500 lbs., which can be increased to 5,300 lbs. by stone ballast in the main roller. With this latter weight the machine will ascend a grade of 22½%. Many of these engines are used in the construction of asphalt pavements. Russell & Co., of Massillon, O., had two 12½-ton rollers of the ordinary type, with loco-tubular boiler and cylinder mounted on the boiler barrel. The dome is close against the smokebox. The steering chain of the fore carriage is led round two grooved wheels on vertical shafts held by brackets riveted to the front end of the water tank under the barrel, and one of these shafts is extended up to the top of the boiler and fitted with a gear wheel worked by a worm on the end of a horizontal shaft with a handwheel. The front roller is partly under the smokebox, and is fitted with a universal joint to allow it to accommodate itself to uneven surfaces. Special patented designs of balanced valves and reverse motion are used, and there is a friction clutch by which the engine may be run at full speed and then by starting the traction gear the momentum in the flywheel utilized to help the engine out of a hole.

In horse rollers there were the Pope, Champion and Austin machines. The reversible five-ton roller of R. C. Pope, of Chicago, was illustrated and described in our issue of Nov. 17, 1892, and the one exhibited was made by the Union Iron Works & Foundry Co., of St. Louis, Mo. The three-ton Champion roller exhibited by the American Road Machine Co., of Kennett Square, Pa., has a small pair of wagon wheels in front, supporting the front end of the roller frame and carrying the pole for the team. The object of this is to relieve the strain on the horses' necks, and the wheels carry but little weight. The weight can be increased by filling stone or iron into two boxes on the frame, one before and one behind the roller. The roller is in three sections, each 14 ins. wide. The F. C. Austin Mfg. Co. had a reversible roller of large diameter, to ride over and crush down obstructions. To reduce the draft it is fitted with roller bearings consisting of a series of steel rollers revolving in the box of the frame and around the shaft. The reversing head is also fitted with anti-friction rollers and is so arranged that the driver can operate it from his seat, as well as manage the roller on hilly work, being supplied with a powerful quick-acting brake placed in front of his seat. These rollers are made in weights of two to seven tons.

Street Sprinklers.

All the street sprinklers shown (there were 22 in service, as already noted) had improvements upon the old plan of using a perforated pipe to distribute the water. The Studebaker Bros. Mfg. Co., of South Bend, Ind., employs an upright cylinder behind each of the rear wheels, and the water flowing through these strikes a saucer-shaped plate at the bottom and is thrown out in a fan-shaped sheet. This arrangement prevents clogging by sediment. The driver has levers by his seat by which he can regulate the quantity of flow according to the condition of the street. The weight is from 2,200 lbs. to 3,600 lbs. There were in service two of the larger ones with four wheels and horizontal cylindrical tanks, and two smaller ones with two wheels and barrel-shaped tank of 150 gallons capacity. Winkler Bros., of South Bend, Ind., had 15 sprinklers, of which there were in service four with vertical tanks, eight with horizontal tanks, and one single hand sprinkler. The larger ones range from 550 gallons capacity and 2,400 lbs. weight, to 700 gallons and 2,500 lbs. In these machines two 4-in. rubber hose pipes lead to horizontal brass cylinders behind the rear wheels, the cylinders being perforated so as to throw the water downward and outward instead of backward. The stop valves are in the cylinders so that there is no flow after they are closed, as is the case where the valve is in the main pipe. The Miller-Knoblock Wagon Co., of South Bend, Ind., exhibited eight sprinklers, of which four with vertical tanks and one with horizontal tank were in service. A cast iron box behind each rear wheel is supplied by a pipe from the tank and is fitted with a hinged sprinkler head of brass, the perforations in this head being made so as to thrown the water downward and outward only, as it is found that many people start to cross a street directly behind a sprinkler wagon. The valves are in the brass heads, thus insuring prompt starting and stoppage of flow. The amount of flow can be regulated within a considerable range. The heads are only 12 to 14 ins. above the street. Slotted instead of perforated sprinklers may be used with dirty water, and the heads can be made to throw the spray behind the sprinkler if desired. The heads are sometimes placed between the wheels. The horizontal tank is recommended, and is of cylindrical section, with flattened bottom, to rest upon the frame. Several of these sprinklers are used by the Street Sprinkling Association, of New York city. The small hand sprinklers used within the buildings consisted of a barrel on small wheels and fitted with a perforated pipe. Some of these threw the jets inward, so as to reduce the chances of wetting peoples' feet. These machines were made by the Lansing Wheelbarrow Co., of Lansing, Mich.

Street Sweepers.

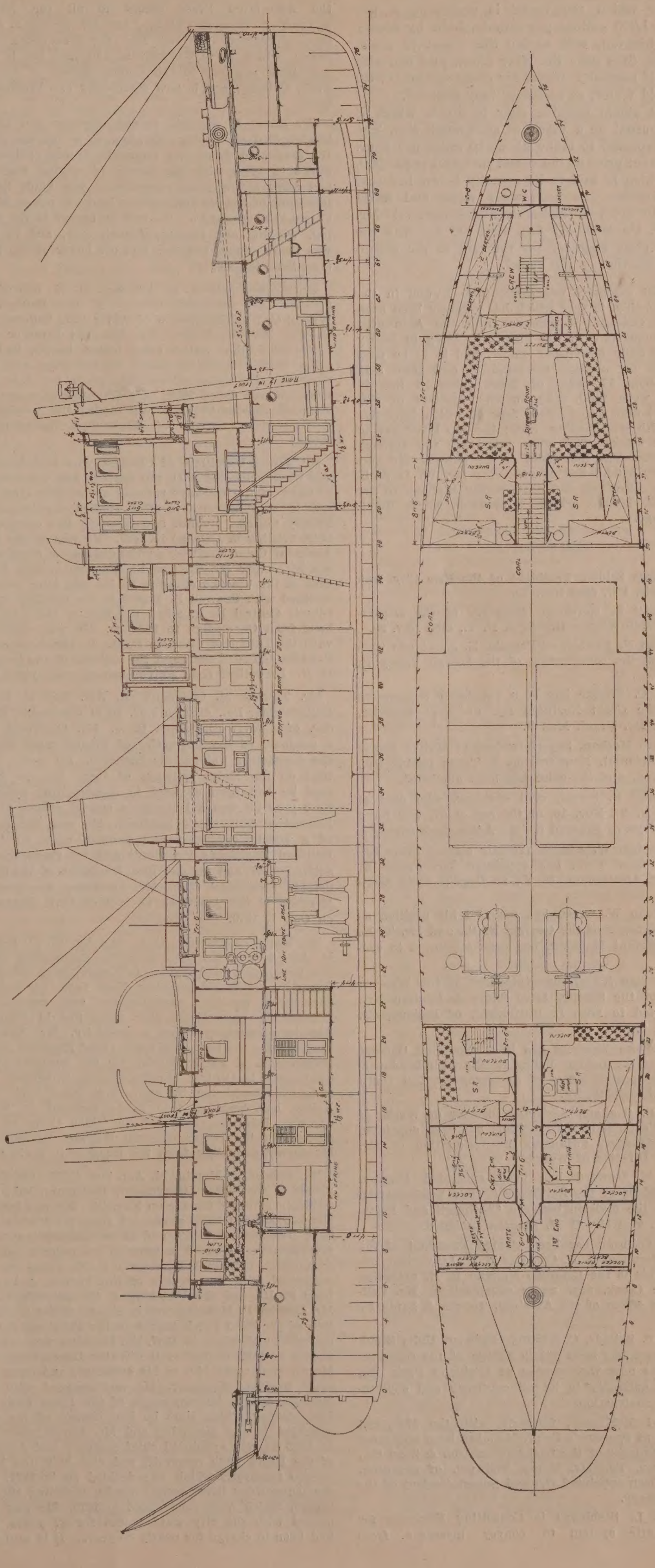
The F. C. Austin Mfg. Co., of Chicago, Ill., included in its exhibit of various kinds of road machinery a street sweeper with framing entirely of channel and T steel. The working parts and gearing are reduced to a minimum. The rear axle, which drives the broom, is of 3-in. cold rolled steel, and the wheels are also of steel. The revolving broom is placed diagonally across the frame, and is of tempered steel wire securely fastened in a solid cylinder. Rattan may be used if desired, but the steel wire is recommended as preferable. Three sweepers were in use on the roadways of the Exposition. Two of these were Chapman & O'Neill's "Pride of New York" sweepers, furnished by Finis Cartwright, of Louisville, Ky., and the third was an Edson sweeper, manufactured by the Edson Mfg. Co., of Boston, Mass. All of these were four-wheeled machines, with link belt driving gear to the revolving brooms.

THE NEW POLICE PATROL BOAT FOR NEW YORK CITY.

Through the courtesy of Mr. Frank B. King, General Manager of the Marine Department of the Maryland Steel Co., we are enabled to illustrate the new patrol steamer for the Police Department of New York city, which was designed and built at the Sparrow's Point yards, and was launched from there on Nov. 18. The vessel resembles in her design and general appearance a large ocean tug. Her dimensions are: Length over all, 143 ft. 6 ins.; length between perpendiculars, 135 ft.; beam, 23 ft.; molded depth, 10 ft. 6 ins.; draft loaded, 6 ft. forward, 8 ft. aft. Her keel is of steel plate 6 × 1½ ins. in section; her stem is 6 × 1½ ins., and her stern post is a steel casting 6 × 3 ins. at the top and 6 × 1½ ins. at the bottom. The hull is built of open-hearth steel, the garboard and sheer strakes of 16-lb. plates, the bottom and bilge of 14-lb., and the fifth strake of 12-lb. She has four transverse bulkheads and is double plated forward for work in ice.

The propelling machinery consists of two compound condensing engines of 250 HP. each, driving twin screws. Steam is furnished by two boilers of gunboat pattern, 7 ft. 9 ins. diameter, and 17 ft. 6 ins. long. Each boiler has two 36-in. corrugated furnaces and 148 tubes, of which 78 are 3-in. and 70 are 3½-in. The larger tubes are placed on the lower half of the tube plate where the draft is lighter and the tubes are more likely to get clogged. The steam pressure is to be 120 lbs. The engines have 13-in. and 24-in. cylinders and 24-in. stroke. The air pump is worked from the low-pressure crosshead. Piston valves are used on the h. p. cylinder and double-ported slide valves on the l. p. cylinders. The link motion is used, with steam reversing gear. The propeller shafts are 5½ ins. in diameter. The screws are 6 ft. in diameter and 9 ft. pitch, and are made of cast iron with 25% of steel scrap. The outer shaft bearings are supported by cast steel hangers.

A complete electrical plant will be placed on board, and current will be furnished to 60 incandescent lamps and a 4,000-c. p. search-light, which is expected to be a useful adjunct in the especial



LONGITUDINAL SECTION AND LOWER DECK PLAN OF THE NEW PATROL STEAMER FOR THE NEW YORK CITY POLICE DEPARTMENT. The Maryland Steel Co., Builders.

work for which the vessel is designed. A fire pump of 1,000 gallons per minute, built by Henry R. Worthington, will enable the vessel to assist in fighting fires near the river front, and can also be used, if necessity arises, for ducking mobs, with hot or cold water, as necessity may demand.

Manton steam steering gear is fitted, which is rather unusual on a vessel of such small size. The boat is expected to make about 16 miles per hour. The contract price of the vessel complete is $52,500, a sum which is said to be actually below her cost to the builders, as her joiner work and finish throughout are very elaborate and expensive. Mr. H. de B. Parsons, M. Am. Soc. M. E., was the superintending engineer for the city in the design and construction of the vessel.

The most extensive pneumatic tube system in the world, probably, is that which has recently been completed at Chicago. It extends from the Associated Press headquarters in the Phenix Building to nearly all of the daily newspaper offices, and is to be used exclusively for sending messages to and from said offices. About 17 miles of brass tubes 3 ins. in diameter were used. The subway consists of five layers of hollow burnt brick, four of which have five bricks, with one opening, each; the top layer having but three bricks. The brass tubes are run through these bricks. The four sides of the subway are surrounded by a 6-in. bed of concrete. Mr. W. L. Stebbings was consulting and constructing engineer to the contractors, Messrs. Wilson & Jackson, Times Building, Chicago.

PERSONALS.

Mr. George Selden, President of the Erie City Iron Works, Erie, Pa., died Nov. 19.

Mr. Daniel L. Northrup, Secretary of the Department of Public Works, Brooklyn, N. Y., died Nov. 20.

Mr. Eaton N. Frisbie, of Passaic, N. J., at one time engaged on the construction of the Lehigh Valley R. R., died Nov. 13.

Mr. W. C. Thorne has been appointed Superintendent of the Great Northern Ry. at West Superior, Wis., vice Mr. Frank Merrill.

Mr. James Meehan, Superintendent of Motive Power of the Cincinnati, New Orleans & Texas Pacific Ry., has resigned, and the office has been abolished.

Mr. Homer B. Sweet, civil engineer, who died at Syracuse, N. Y., Nov. 16, at the age of 67, was for a number of years engaged on the Adirondack survey.

Mr. Campbell W. Adams, recently elected State Engineer of New York, has appointed Mr. Frank R. Becker, of Amsterdam, N. Y., as Deputy State Engineer.

Major John W. Green has resigned his position as General Manager of the Georgia R. R., and Mr. T. K. Scott, Assistant Manager, has been appointed to succeed him.

Mr. Newman Kline, Superintendent of the Western Division of the Seattle, Lake Shore & Eastern Ry., was married to Miss L. Butterfield, of Indianapolis, Ind., Nov. 2.

Mr. Theodore Voorhees has been appointed General Manager of the Lehigh Valley R. R., with headquarters at the general office of the company, 228 South 3d St., Philadelphia, Pa.

Mr. F. R. Graham, Assistant Director of Works of the World's Columbian Exposition, has been appointed General Manager, owing to the resignation of Mr. Burnham, Director of Works.

Mr. C. H. Howard has been appointed Division Superintendent of the Baltimore & Ohio Southwestern R. R., on the division between Cincinnati and Portsmouth, O., vice Mr. C. M. Stanton, resigned.

Mr. H. Collbran has been elected President of the Midland Terminal R. R. Co., vice H. P. Lillybridge, resigned. This is the Colorado Midland R. R. extension to Cripple Creek, now under construction. Mr. Collbran is an officer of the Atchison, Topeka & Santa Fe R. R.

Mr. W. S. Shields, Consulting Engineer, Unity Building, Chicago, has been put in charge of the construction of the new water-works at Highland Park, Ill., with full authority to let all contracts and superintend the construction.

Mr. Carl McKinney, formerly with the Maryland Steel Co., at Sparrow's Point, Md., has been appointed General Manager of the Lackawanna Iron & Steel Co., at Scranton, Pa. Mr. Henry Wehrum, of Scranton, Pa., has been appointed General Superintendent of the same company.

Mr. W. L. Stebbings is Consulting Engineer for a pneumatic system to convey messages from the Associated Press offices to all the leading newspaper offices in Chicago, and for Wilson & Jackson, contractors for the 10½ ft. Wentworth Ave. sewer, which is to be built in Chicago. He is also consulting engineer to the Commissioners of Lincoln Park, Chicago, and is now completing two bridges for them.

Mr. Anton F. Emrich, mining engineer and metallurgist, died at Pueblo, Colo., Oct. 6, at the age of 35. He graduated from the Columbia College School of Mines in 1882, with the degree of mining engineer, and after a few years' experience was made Superintendent of the Madonna silver lead ore mines of the Colorado Smelting Co. He was an expert in the judging, working and testing of such ores, and in 1887 was made mining engineer and ore buyer of the Montana Smelting Co.

Mr. Stephen Wilcox, M. Am. Soc. M. E., one of the founders and principal owners of the Babcock & Wilcox Co., manufacturers of water tube boilers, died on Nov. 27. Mr. Wilcox was the first inventor who constructed the water tube boiler having inclined tubes connecting water spaces at the front and rear with a steam space above. His patent on this construction was dated 1856. Mr. Wilcox was a member of the Engineers' Club and was made a life member of the American Society of Mechanical Engineers in 1880.

Mr. James Hamilton, of Chicago, who died Nov. 19, had been connected with the surveys and construction of many of the railways running out of that city. He was born in England, in 1824, studied engineering at Trinity College, Dublin, and came to this country in 1841, settling in Chicago in 1847. He was at one time Assistant Chief Engineer on the Chicago & Northwestern Ry. under Mr. Thomas B. Blackstone, now President of the Chicago & Alton R. R., and later was associated with Roswell B. Mason in the building of the Illinois Central R. R. when the first of the line was built from Champaign to Chicago. He was connected with the Detroit & Maumee R. R. In 1850 he went to Panama and took charge of the building of the Panama R. R. He retired from active business some years ago.

Mr. Thomas M. Cleemann, M. Am. Soc. C. E., of Philadelphia, Pa., died on Nov. 16 at Guayaquil, Ecuador, of a fever contracted there. Mr. Cleemann was a graduate of the University of Pennsylvania and of the Rensselaer Polytechnic Institute. He spent some time on the Meigs railways of Peru, but for years past he had been engaged in a consulting practice. Last year he was a lecturer in special course at the Rensselaer Polytechnic Institute. He was the author of a widely circulated and popular work on "The Railroad Engineer's Practice," and for years was an active officer, and for one term President of the Philadelphia Engineers' Club. Mr. Cleemann was made a Member of the American Society of Civil Engineers on Oct. 1, 1879.

Mr. Theodore Paschke, C. E., and Mr. W. D. Kelley, M. Am. Soc. C. E., have formed a partnership under the firm name of Paschke & Kelley, with office at Room No. 90 World Building, New York, for general engineering practice, examinations and reports on engineering enterprises and properties in Spanish-American countries being a specialty. Mr. Paschke has been for the past nine years Chief Engineer of the Department of Public Works for the government of Guatemala, in Central America, having previously had a longer experience in and about New York. Mr. Kelley has been of late years engaged in South America, being in charge of the Third Corps of Engineers for the Intercontinental Railway Commission, his survey extending from the Equator to Bolivia.

Mr. Robert K. Martin, M. Am. Soc. C. E., Chief Engineer of the Water Department, Baltimore, Md., died suddenly of heart disease on Nov. 24. He was born in Denton, Md., in 1835, graduated from St. Mary's College, Baltimore, in 1852, and after studying law for a few months accepted a position as rodman on the Alexandria, Loudon & Hampshire R. R. Later he was connected with the surveys of the Norfolk & Petersburg R. R., and the Pittsburg & Connellsville R. R. Mr. Charles P. Manning was in charge of the construction of the Sand Patch tunnel on the Pittsburg & Connellsville, and when, in 1857, Mr. Manning went to Baltimore to take charge of the Water Department, Mr. Martin went with him as his assistant, and later was made Resident Engineer. He was engaged with Mr. Manning in the improvements of the Jones Falls till 1861, during which time he had charge of the construction of the Hampden and Mt. Royal reservoirs. In 1863 he was appointed chief engineer and designer of the Druid Lake reservoir, and also built the high-service reservoir, which was decided on in 1871, and the Gunpowder River supply works, including the big tunnel, which were commenced in 1875. He was connected with the city water-works for 37 years, and had been in charge for nearly 30 years. It is said that Mr. Martin was consulted by the New York authorities in the matter of the construction of the water-works, and was offered the position of consulting engineer at a salary of $10,000 a year—three times as much as he received at Baltimore ($3,600), but he would not accept. He was also connected as engineer with the construction of water-works at Hagerstown and Annapolis, Md., and Hanover, Pa., and was consulted in connection with other works and projects.

NEW PUBLICATIONS.

MASSACHUSETTS STATE BOARD OF HEALTH.—Report for the Year Ending Sept. 30, 1892. S. W. Abbott, M. D., Secretary; F. P. Stearns, M. Am. Soc. C. E., Engineer; 8vo; pp. 806; tables and illustrations.

If possible this report is of greater interest and value than its predecessors, owing to the increased knowledge available as the result of another year of experiment and study.

The report contains the results of sanitary examinations of many of the water supplies of the state, a summary of the water supply statistics, and advice given to cities and towns regarding both water supply and sewerage. There are also a number of special papers relating to the sanitary aspects of water supply and sewerage, prepared by members of the chemical and biological forces of the board. Prof. Thos. M. Drown has a paper on the "Interpretation of Water Analysis" and one on "The Amount of Dissolved Oxygen in the Water of Ponds and Reservoirs at Different Depths in Winter Under the Ice." The latter paper supplements one which appeared in the report for 1891 regarding dissolved oxygen in summer months. Another paper of Professor Drown is "On the Mineral Contents of Some Natural Waters in Massachusetts." Mr. Gary N. Calkins contributes a paper entitled "A Study of Odors Observed in the Drinking Waters of Massachusetts," and another on the "Seasonal Distribution of Microscopic Organisms in Surface Waters." Connection between specific organisms and specific odors is traced, rendering these two papers highly interesting.

The Lawrence experiments on the purification of sewage by intermittent filtration are reviewed for the year by Mr. Allen Hazen, and these results, as given in advance pages, were set forth in our issue of Sept. 28, 1893. Two of the papers by Mr. Hazen, one on "Some Physical Properties of Sands and Gravels, with Special Reference to Their Use in Filtration," and one by Mr. Geo. W. Fuller, giving the latest results at Lawrence in water purification by sand filtration, are abstracted in this issue in the series of articles on "Water Purification in America."

One of the most valuable parts of the report is a comparison of the results, as indicated by analyses, obtained from the intermittent filtration plants for the purification of the sewage of South Framingham, Marlborough and Gardner, Mass. (see Eng. News, Aug. 11 and 25, 1892, and Feb. 16, 1893). With the exception of the section on the "Health of Towns" the volume closes with a number of admirable reports on recent epidemics of typhoid fever in Massachusetts. Most of these reports are by Prof. W. T. Sedgwick and are the results of personal investigation in the localities affected.

The reports are embellished with maps printed in colors and reproductions of photographs and are further illustrated by diagrams. Several of the epidemics are attributed to water supplies contaminated by human excrement; others are thought to have been caused by infected milk, and some slight ones were apparently due to secondary infection. The effect of these particular investigations and of the work of the board in general upon the health of the state must be very beneficial, while as a contribution to the world's knowledge and as a stimulus to investigation by others this and the previous reports of the board deserve the highest praise.

PROCEEDINGS OF THE ASSOCIATION OF ONTARIO LAND SURVEYORS, at its first annual meeting, held at Toronto, Feb. 28 and March 1 and 2, 1893. A. J. Van Nostrand, Secretary. Toronto. 8vo; pp. 161; illustrated.

In addition to the report of the proceedings there are reports of committees on land surveying, drainage and engineering, and the following papers: "Geographical Surveying," L. B. Stewart; "History of the Tache Gold Field," Henry D. Sewell; "Timber Surveys and Explorations," J. F. Whitson; "The Duties of a Land Surveyor on the Maintenance of Way Staff of a Railway," W. L. Innes; "Local Improvements," P. S. Gibson; "Plea for a Topographical Survey," Willis Chipman; "Shall It Be a Tile Drain?" Herbert J. Bowman; "The Mexican Amalgamation Process," Samuel Bray; "Permanent Street Pavements, Their Durability and Cost," J. W. Tyrrill; "The Education of Our Draftsmen," F. L. Foster; "The Transit and How to Use It," Cyrus Carroll; "Drainage Difficulties in the Southwestern Municipalities of Ontario," Henry Winter. There is also a biographical sketch, with portrait, of Thomas Ridout, who was Surveyor-General of Canada in 1810.

STANDARD TABLES FOR ELECTRIC WIREMEN; with instructions for Wiremen and Linemen, Underwriters' Rules and Useful Formulas and Data. By Chas. M. Davis. Fourth edition; revised and edited by W. D. Weaver. New York: The W. J. Johnston Co., Ltd. 16mo; flexible morocco; pp. 128; $1.

The third edition of this useful little book was exhausted some months ago, and the present edition has been delayed in order that it might contain the latest revisions of the Insurance Rules of the Underwriters' International Electric Association. An important addition is a section on the calculation of wiring for alternating currents, giving tables by which conductors for such circuits can be proportioned very accurately. The book also contains general instructions for wiremen and linemen, various tables for calculating continuous current wiring, rules for calculating horse power of engines and boilers, etc. The rule for calculating horse power of boilers is said to be based on 40 lbs. of water per I. HP. Thirty pounds is the standard adopted by the American Society of Mechanical Engineers, and conforms much more nearly to modern practice.

TRADE PUBLICATIONS.

ADDYSTON PIPE & STEEL CO., Cincinnati, O. 8vo; pamph.; pp. 9.

This little pamphlet contains some reprints of papers respecting the use of cast iron pipe for culverts, extending to sizes as large as 60 ins. in diameter, with tables of weights of standard water and gas pipe and standard specials. There is also a description of a reversible road roller for use with horse traction. Instead of the customary boxes for loading the roller with rock ballast when extra weight is needed, the roller is made water-tight, with a valve for filling and emptying. The five-ton roller, when filled with water, weighs eight tons.

WELL SINKING; MINING AND PUMPING APPLIANCES.—American Well Works, Aurora, Ill. 8vo; pp. 448; illustrated.

This is a very comprehensive illustrated catalogue and price list of all kinds of machinery, tools, appliances and general supplies used in well sinking, prospecting, mining, pumping, etc. Some of the company's well sinking plants have been described in our issues of Aug. 11 and Dec. 15, 1892, and Oct. 26, 1893. The catalogue contains a large amount of useful and practical information, with tables of dimensions and prices of the various machines and supplies.

THE WIDENING USE OF COMPRESSED AIR.—By Whitfield Price Pressinger. New York: Clayton Air Compressor Works. 8vo; pp. 7.

This pamphlet is a reprint of an article in the "Engineering Magazine," and describes in brief the various purposes to which compressed air power has been applied.

SOCIETY PROCEEDINGS.

KANSAS IRRIGATION ASSOCIATION.—At the convention held at Wichita last week the following permanent officials were elected: President, D. N. Frost, Garden City; Secretary, E. B. Cogwill, Topeka; Treasurer, J. E. Greendee, Hutchinson; Consulting Engineer, H. V. Hinckley, Topeka.

ASSOCIATION OF ENGINEERS OF VIRGINIA.—At an informal meeting held Nov. 15 the subject for discussion was "The Slide Rule and Similar Aids to Calculation." The discussion was opened by Mr. M. E. Yeatman, who explained the principal of the plain slide rule and the method of use, with numerous examples, and gave an explanation of the advantages to be gained by a circular slide rule arising from its greater length of graduation. He explained the method of making and using it. Thacher's cylindrical slide rule, having an effective length of scale of 30 ft., was next explained. Mr. Yeatman closed by giving a comparison of the accuracy of the three types of slide rules as follows: The plain slide rule, 10 ins. long, gives results accurate to within 1 in 216; the circular slide rule, 8 ins. diameter, gives results accurate to 1 in 1,080; the Thacher cylindrical slide rule gives results accurate to within 1 in 15,400, assuming in each case that graduations can be read to within 1-100 in.

Mr. G. R. Henderson presented a specimen of logarithmic cross-section paper (Eng. News, Sept. 28), and explained its application to the graphical solution of formulas. This paper was designed by W. F. Durand, of Cornell University, and is manufactured by Andrews & Church, of Ithaca, N. Y., costing 60 cts. per quire, the sheets being 11 ins. square. In the discussion Mr. de Saussure explained the application of the logarithmic spiral curve to the same uses as the slide rule.

The subjects for the coming monthly meetings were announced as follows: "The Sewerage System of Roanoke," "Railway Signaling," "Aluminum Alloys," "Modern Boiler Practice." At the meeting on Dec. 20 the first of these will be discussed.

L. J. Carmalt, Secy.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The coming annual meeting will be held at the society's house, 12 West Thirty-first St., New York city, the first session opening at 8:30 p. m., Monday, Dec. 4, with an address by President Eckley B. Coxe. Sessions for the reading and discussion of papers will be held at 10 a. m. on Tuesday, Wednesday, Thursday and Friday, and at 8:30 p. m. on Tuesday. On Wednesday evening a reception and conversazione will be held for members and their ladies at Sherry's, Thirty-seventh St. and Fifth Ave. The list of papers and authors announced for the meeting is as follows: A. K. Mansfield, "The Buckeye Engine Valve Gear"; R. H. Thurston, "The Maximum Contemporary Economy of the High-Pressure Triple Expansion Engine"; Geo. A. Morison, "Expansion Bearings for Bridge Superstructures"; Barton Cruikshank, "A Device for Drill Jigs"; Fredk. A. Scheffler, "A Curve Delineator"; Fred. W. Taylor, "Notes on Belting"; R. C. Carpenter, "Some Experiments on the Effects of Water Hammer"; R. C. Carpenter, "Constants for Correcting Indicator Springs Which Have Been Calibrated Cold"; W. S. Aldrich, "The Use of the Indicator in Dynamometric Testing"; R. C. Carpenter, "A New Form of Prony Brake"; D. S. Jacobus, "A Comparison of Mean Effective Pressures of Simultaneous Cards Taken by Different Indicators"; H. L. Gantt, "Recent Progress in the Manufacture of Steel Castings"; Wm. A. Pike, "Steam Piping and the Efficiency of Steam Plants"; Chas. H. Manning, "A Method of Manufacture of Large Steam Pipes"; Jas. B. Stanwood, "Strength of Rim Joints in Flyband Wheels"; R. C. Carpenter, "Experimental Determination of the Effect of Water in Steam on the Economy of the Steam Engine"; F. A. Scheffler, "Test of a Boiler Using Grates with a Small Percentage of Openings"; Wm. A. Rogers, "The Cumulative Errors of a Graduated Scale"; Wm. H. Francis, "A Modern Disinfecting Plant"; W. S. Crane, "Crucible Furnace Using Petroleum"; David Guelbaum, "Theory of Direct-Acting Steam Pumps."

NEW YORK RAILROAD CLUB.—The annual meeting was held on Nov. 23, and the largest number ever recorded at any meeting of the club was in attendance. The reports of the officers showed a total membership at the present time of 341, against 217 one year ago. The club has $1,774 cash in its treasury, against $772 a year ago. It was voted to change the size of the printed report of proceedings to correspond with the standard adopted by the M. C. B. Association, and to send a copy regularly to every member of every railway club in the United States.

The subject for technical discussion was the paper read by D. L. Barnes, Mem. Am. Soc. M. E., at the last meeting, on boiler explosions and methods of preventing them by inspection. It was participated in by Messrs. Mitchell, West, Sinclair, Mongomery, Joggins, Dixon, Rogers, Forney and others. The methods of inspection proposed by Mr. Barnes were declared to be impracticable and needlessly onerous to secure reasonable safety. The use of fusible plugs was condemned by several, especially where bad water was in use, as scale is apt to form over the plug and cause it to be overheated and melted. Several had tried zinc for the prevention of corrosion and pitting in boilers, with excellent success. The use of hollow stays for the detection of breakage, while generally commended, was said to be not an infallible method of indicating breakage, as the hole in the stay may get stopped up, or the stay may break so slowly that the crack will fill with scale as fast as it forms, and no water will escape from it. The hydraulic test was also recommended, as a valuable additional safeguard, though not removing the necessity of careful inspection. Mr. West showed samples of stays which were not broken entirely off but were separated over from ¼ to ¾ of their section, and asked whether hammer inspection could be relied on to detect such stays. He also showed some pieces of boiler plate which had failed by serious pitting near the mud ring, after a very few months of service. Copies of the full verbatim report of the proceedings may be obtained by addressing the Secretary, Mr. John W. Hill, Temple Court, New York city.

Following the technical discussion the annual election of officers took place, and all the officers who have served during the past year were re-elected. At the December meeting a "smoking concert" will be held. and the members of the New England and Central clubs are to be invited.

ENGINEERS' CLUB OF PHILADELPHIA.—Meeting of Nov. 18, 1893. President John Birkinbine in the chair and 56 members and visitors present. In opening the general discussion announced for the evening, on the subject of riveting, Mr. Wilfred Lewis referred to a number of letters received expressing interest in the subject, and read a letter from Mr. David Townsend stating that he was prepared for the manufacture of rivets to be driven cold, a number of which were exhibited. In regard to the pressure required for driving such rivets, Mr. Lewis recalled some experiments made by William Sellers & Co., between the compression platforms of their testing machine. A number of ⅝-in. rivets were subjected to pressures between 10,000 and 60,000 lbs. At 10,000 lbs. the rivet swelled and filled the hole without forming a head. At 20,000 lbs. the head was formed and the plates were slightly pinched. At 30,000 lbs. the rivet was well set. At 40,000 lbs. the metal in the plate surrounding the rivet began to stretch, and the stretching became more and more apparent as the pressure was increased to 50,000 and 60,000 lbs. From these experiments the conclusion might be drawn that the pressure required for cold riveting was about 300,000 lbs. per sq. in. of rivet section. In regard to the pressure for hot riveting, he said that until quite recently, within the last decade, there was never any call for a pressure exceeding 60,000 lbs., but that now pressures as high as 150,000 lbs. were not uncommon, and even 300,000 lbs. had been contemplated as desirable. Mr. James Christie said: I remember many years ago in the West they used to drive boiler rivets cold, but afterward abandoned it on account of the deterioration in quality of the rivet iron. Since critical systems of inspection and testing material have become common, the importance of having rivets solidly driven has been more thoroughly appreciated than formerly. Hand work is avoided where possible, and higher pressures are used than before. Machines are preferred that will deliver the maximum pressure to the rivet with certainty. The direct hydraulic ram has the advantage of compactness, and when its fluid is stored in an accumulator there is a sudden impact or elevation of static pressure on the rivet at the termination of each stroke—a circumstance highly favorable to the riveting operation. It has been found in girder work that for red hot rivets of iron or soft steel, with length of grip not exceeding three diameters, a pressure of 50 tons per sq. in. of rivet section has been sufficient to completely fill the hole. Longer rivets require higher pressure, and in extreme cases this pressure must be doubled to secure solidity. The shape of the head can be modified to a form favorable for the flow of metal into the body. A paper by Mr. Pierre Giron, on the grinding of Portland cement, was then read by title and discussed.

COMING TECHNICAL MEETINGS.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Dec. 1. Secy., E. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Dec. 1. Secy., O. Von Geldern, 719 Market St., San Francisco.
ENGINEERS' CLUB OF PHILADELPHIA.
Dec. 2. Secy., L. F. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
Dec. 2. Secy., P. Valentine. At 281 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 4 to 8. Secy., F. R. Hutton, New York.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Dec. 4. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Dec. 5. Secy., W. Halliburton.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Dec. 6. Secy., F. Collingwood, 127 East 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
Dec. 6. Secy., Arthur Thacher, Odd Fellows' Building.
WESTERN SOCIETY OF ENGINEERS.
Dec. 6. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Dec. 7. Secy., C. H. McLeod, Montreal. P. Q.
ENGINEERS' CLUB OF MINNEAPOLIS.
Dec. 7. Secy., E. Nexsen, 504 Kasota Block.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Dec. 9. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
Dec. 11. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
Dec. 11. Secy., M. F. Schinke, City Hall.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Dec. 12. Secy., F. C. Osborn, Case Library Bldg.
DENVER SOCIETY OF CIVIL ENGINEERS.
Dec. 12. Secy., F. E. King, Jacobson Block.
NORTHWEST RAILROAD CLUB.
Dec. 12. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Dec. 12. Secy., D. W. McMorris, Burke Block, Seattle, Wash
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Dec. 13. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Dec. 13. Secy. F. M. Curtis, P. O. Box 1576, Boston.
ENGINEERING ASSOCIATION OF THE SOUTH.
Dec. 14. Secy., W. G. Kirkpatrick, Nashville, Tenn.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Dec. 14. Secy., F. W. Mowbray, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Dec. 15. Secy., D. W. Meeker, St. Paul.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Dec. 15. 201 Washington Building.
COLUMBIAN ENGINEERING SOCIETY.
Dec. 19. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Dec. 19. Secy., R. H. Clark, Pittsburg.
WESTERN RAILWAY CLUB.
Dec. 19. Secy., Clement F. Street, Chicago.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Dec. 20. Secy., L. J. Carmalt, Roanoke, Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Dec. 20. Secy., S. E. Tinkham, 36 Broomfield St.
ENGINEERS' CLUB OF CINCINNATI.
Dec. 21. Secy., J. F. Wilson, 24 W. 4th St.
NEW YORK RAILROAD CLUB.
Dec. 21. Annual meeting. Secy., John A. Hill, Temple Court.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO
Dec. 21. Secy., Allen Strale, 100 Washington St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Jan. 18. Secy., S. A. Charpiot, Macon, Ga.
CENTRAL RAILWAY CLUB.
Jan. 24. Secy., S. W. Spear, Buffalo, N. Y.

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ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

The advantages of properly built and well maintained dirt roads seem to have been largely overlooked in the movement for the improvement of our country roads, and it has been said, with some reason, that the movement in favor of good roads has been hampered to some extent by a somewhat too enthusiastic advocacy of broken stone roads, either macadam or telford. The cost of such stone roads is absolutely prohibitive of their adoption in many parts of the country, where, however, improved roads are urgently needed. Comparatively little is said about dirt roads in the discussion on improved construction, but it is certain that very excellent roads may be made of earth by a proper system of construction. Both surface drainage and sub-drainage are essential in obtaining a durable road, and intelligent maintenance is another essential, which latter is rather difficult to insure. The mere dumping of piles of earth in wet spots or low places is not maintenance, but is mere waste of energy due to carelessness or misdirected zeal. With a good dirt road once completed, it would probably be found economical and advantageous to intrust its maintenance to a few skilled and intelligent men paid for their services, instead of leaving the maintenance to the spasmodic attention of the farmers and their hired men. In our issue of Nov. 16 we published an abstract of an interesting paper on dirt roads. The improvement of country roads is to be aided by the government to the extent of initiating a systematic investigation into the road laws and the systems of road construction, maintenance and management which prevail in different parts of the United States, and some particulars of the character of this investigation were given in our last issue. It is to be expected that much valuable information will be gathered, which should be carefully digested and arranged before its publication.

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A curious illustration of the enormous values to which the "unearned increment" sometimes rises was afforded by the sale this week of a small lot, 22½ × 64½ ft., at the corner of Broadway and Pine St. at the round price of $400,000, or at the rate of $286 per sq. ft. An acre of land at this rate is worth $12,458,160, or at the rate of but little less than $8,000,000,000 per square mile. At this rate it would require but 10 square miles, or about one-third of the area of Manhattan Island, to equal in value the entire estimated wealth of the United States, real and personal, and this quite apart of any improvements on the land, other than the existing adjacent streets.

The time is yet far off, perhaps, when any but selected small areas will sell at so high a rate, and yet at least one small area has sold at more than double this rate, and on the very day of this sale another and larger lot, 37 × 80 ft., at the corner of Nassau and Pine Sts., was sold at $600,000 to $700,000, or at the rate of $215 to $251 per sq. ft., and a small side street lot in the same vicinity, 45 Liberty St., at $80 per sq. ft. Large as these values are it will not be many years before they are again doubled, if we may judge of the future by the past; and inasmuch as the increment results solely from the general activity of the public and in no respect from exertions of the owner, the abstract equity of the position that what the public creates should go to the public, which is the "single tax" theory, is very clear. But how that theory is to be applied with justice to individuals, and so as to do more good than evil, remains a problem.

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A correspondent writes us:

> I have lately made some observations showing that one of the largest bridges of the country (and probably many more of them are affected in the same way) is too severely pounded by the car wheels. This pounding may be the result of flattened wheels, or unequal height of rails at fish plates or connections. Such pounding under heavily loaded trains is certainly injurious to the life of a bridge, especially if of long span. The rails should be kept at equal heights at joints, the car wheels should be kept perfectly rounded, and on long span bridges it might be well to have the track laid on springs to relieve the bridge from strains produced by pounding or heavy jarring.

There is no doubt whatever that such causes do produce a good deal of extra strain on bridges, and being dynamic in their nature they tend far more to wear and overstrain than much greater static strains. There is no doubt also that flat wheels frequently are left for a long time under freight cars, and occasionally for a shorter time under passenger cars. Our correspondent is in error, however, in saying that these defects are especially injurious to the life of long spans; the direct contrary is the case; because of the greater ratio of dead to live load in long spans. Neither do we believe that defective joints are a specially serious cause of trouble to bridges. The inequalities of load caused by the centrifugal force of the counterweights in the locomotive drivers, of which there is no outward sign whatever, probably do more harm than the joints and flat wheels together. For all these causes alike, however, a certain elasticity in the track is desirable. The difficulty is how to get it without doing more harm than good, which any sort of spring support to the rails probably would do. The floor system as ordinarily constructed may in some degree be considered as a spring support, and doubtless considerably eases the sudden shocks before they ever reach the hangers, still more the trusses.

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The excellent record made by the triple-screw cruiser "Columbia," in her late official trial at Boston, is gratifying, not only to her designers at Washington, but to the whole country, as evidence of the marked progress made in shipbuilding in the United States within the last decade. For her displacement of 7,350 tons, the "Columbia" is now the fastest warship afloat, and from the behavior of the machinery in the trial trip in the open sea her builders are confident that she will yet exceed in actual speed the official 22.8 knots obtained at the trial. The indicated horse power will reach 22,000, says Mr. E. S. Cramp, who had charge of the vessel in her trial trip, and the "Columbia" has already demonstrated the fact that with the side screws alone working, and with 140 lbs. of steam and 113 to 116 revolutions per minute, she can steam at the rate of 18.87 knots per hour. The absence of all wave, says Mr. Cramp, was another remarkable feature of the trial. The triangular foaming cataract at the stern had its apex 10 ft. from the ship and then subsided in height as it spread in width until it disappeared 50 ft. farther aft into a series of gentle waves. The light bow wave and the absence of vibration in the hull at maximum speed, taken in connection with the behavior of the engines and boilers, all speak volumes for the consummate skill, knowledge and foresight of the designers and builders of this new warship.

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As before remarked in this journal, the triple-screw arrangement is not new in itself, for it has been actually used for some years past on French, German and Italian ships, and even the proper relative position of the three screws, in horizontal and vertical planes, had been previously well ascertained by the French. In the case of the "Columbia," designed to be equipped with unprecedented engine power, for the American navy, twin screws were impracticable. Each shaft would have had to carry 10,500 HP., and the production of these heavy shafts would have caused great delay and their use would have been attended with great risk. Under these conditions Commodore Melville wisely adopted the triple-screw system and improved upon previous practice from the experience gained by foreign builders. That his department has succeeded, in ship and machinery, the late trial bears sufficient evidence. Aside from the division of shaft-strain, from a manufacturer's point of view, a marked economy in cruising is gained from this arrangement. Each of the three screws is fitted with a disengaging device, and thus presents little drag or resistance to the progress of the ship. By this arrangement one, two, or all three screws can be used as occasion may demand, with a corresponding economy in engine power and fuel required. Then, too, this system permits a reduction in the diameter of the screws, a consequent deeper immersion of the screw and less "racing" in heavy weather. This latter feature is especially true of the center screw, which, in the "Columbia," is 15 ft. aft of, and 4½ ft. lower than, the two side screws, and practically means a gain in speed, in heavy weather and with a rolling ship, over a twin-screw steamer of equal engine power. It is altogether possible that the experience with the "Columbia" will lead to a wider application of the triple-screw system to fast steamers of all kinds where excessive engine power and speed are demanded.

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In the line of our late editorial on the navy line and staff controversy, it is impossible to refrain from remarking that the judgment, technical knowledge and mechanical skill that can produce a "Columbia" should, with comparatively little added knowledge of routine work, be also fully equal to the task of commanding and fighting her in any emergency. The converse is certainly true, that the line officer, as compared with the engineer, would have to add an immeasurably greater volume to his general stock of nautical knowledge before he could either design or practically handle his ship. A long time will probably yet elapse before all fighting officers aboard ship will also be engineers. But each new achievement of the staff engineer corps is making it more evident that they are altogether deserving of a higher official standing than present law permits, and that any existing corps prejudice is a relic of a condition of affairs that has passed away forever, as far as the modern navy is concerned.

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The promoters of great railway schemes, who having been hibernating during the financial stringency of the past summer, are gradually coming out of their holes as the improvement in financial conditions continues, and are resuming their interesting contributions to the daily press. In the populist states west of the Mississippi the old scheme of an "air line" north and south railway from some point in Dakota, at present undefined, to some point on the Gulf of Mexico, equally undefined, is reasserting itself; and, if we may believe the newspapers, it is receiving more or less "moral support" from various populist state officials, a support which will hardly be of much aid to it in securing the $25,000,000 capital which would be required for its construction. That the Gulf route to Europe might offer some advantages to the export grain trade, is certainly true, in theory at least; but it does not follow that a "north and south air line" west of the Mississippi, some 1,200 miles in length, is one of the probabilities or possibilities of the near future.

A scheme which comes closer home and one to which the newspapers have been giving especial notice recently is an elevated electric railway between New York and Chicago, on which, of course, the speed is to be 100 miles an hour, the bull's eye which all promoters of high-speed railway schemes are trying to hit. The newspaper reporter naively remarks that "if a person had to travel at that exceedingly high rate of speed without any assurance of safety, the success of the road would be doubtful," a fact which certainly cannot be gainsaid. To allay all fears, however, the company has, "among its numerous patents," one on a mechanical device which keeps the cars securely on the track.

Among the further details of this interesting scheme is the statement that the road is to be a double track line; and to overcome danger from misplaced switches, "there will be no switches throughout the entire line." We are not informed whether this feature is patented. The company proposes to eschew freight traffic and transport nothing but mail, express and passengers. It might be supposed that some difficulty would be met in securing the money for so large an enterprise in these times; but the reporter informs us that "it will require $100,000,000 to build the road and that amount of capital is in sight." Who it is that is in sight of it, he unfortunately fails to specify. The thing that is bothering the promoters is not lack of capital by any means, but the difficulty of obtaining a route through Ohio. A student of the maps might suppose this to be because there was not room enough for more railway tracks in the eastern part of the state, but the reporter explains that the company has found it difficult to secure charters in Ohio, and that for that reason it may be found necessary to skip Ohio and use Canadian territory instead. At present, however, the contemplated route is via Philadelphia, Pittsburg, Cleveland, Sandusky and Toledo. The only parties whose names are given in connection with the scheme are one Dr. J. C. Anderson, of 1019 Euclid Ave., Cleveland, and ex-Secretary of the Treasury Foster. The reporter remarks that "the scheme has been in a state of incubation for the past two years"; which tempts one to suggest that an ordinary egg when subjected to the same process for so long a time would arouse some suspicion in the minds of its owners that it might be rotten.

* * *

A considerable number of contracts have been let recently for pumping engines of very large capacity, and at figures which reflect doubtless the present low prices in the iron and labor markets. The list of bidders and prices on the various contracts have been duly reported in our "Construction News" column; but the matter seems of sufficient general interest to warrant its recapitulation here as follows:

Location.	Capacity of engine, galls.	Lowest bidder.	Price bid (per engine).
Providence........	15,000,000	Geo. F. Blake........	$52,787
St. Louis (two).....	10,000,000	H. R. Worthington...	77,500
St. Louis (two). ..	30,000,000	E. P. Allis.............	78,000
Philadelphia (one)	20,000,000	H. R. Worthington...	65,000
Philadelphia (four)	20,000,000	H. R. Worthington...	61,750
Pittsburgh (two)..	10,000,000	Holly Mfg. Co........	73,910
Dayton, O. (one)...	15,000,000	Holly Mfg. Co........	53,975

Besides the above, New York recently received bids for two 10,000,000-gallon and two 4,000,000-gallon pumping engines with boilers and appurtenances complete, on which the lowest bidder was the Geo. F. Blake Mfg. Co., $110,000.

Of course differences in the head under which the engines work, and other circumstances in connection with the individual contracts, make the several prices comparable only in a broad and general way. The head on the 30,000,000-gallon engines at St. Louis, for example, varies from 40 ft. at extreme low water to 10 ft. or less at high water.

We believe that, in practically all the above cases, the engines are designed for high duties; say, 100,000,000 ft.-lbs. per 100 lbs. of coal or more. The fact that high duty engines of large size can now be purchased at such low figures should encourage the substitution of such machinery for the older and much more wasteful types of pumping machinery wherever the price of coal is high enough to make fuel economy an object.

ELECTRIC MOTORS FOR CANAL-BOAT PROPULSION.

The experiments in the electric propulsion of canal-boats which were undertaken recently on the Erie Canal, near Rochester, have deservedly attracted great attention, and are likely to lead to important results commercially. Of course, from one point of view, the experiments produced few or no results of practical value to the engineer. The electrical apparatus used was merely adapted from that in use on the local street railway. The canal-boat was one of the ordinary hulks to which steam propulsion has been adapted, and was prepared for the test by removing the boiler and engine, and substituting two 25-HP. Westinghouse single reduction motors in its place. Thus, from the engineer's standpoint, the so-called experiments really involved nothing of an experimental nature. It was known beforehand that the canal-boat when equipped with its engine, boiler and screw propeller would move at a reasonable speed. It was also known that the electric motor used would turn a shaft with a certain power when furnished with current of a certain quantity and potential. It required only an elementary process of logic, therefore, to conclude that when the electric motor was substituted for the steam engine, and proper appliances for furnishing the motor with current were provided, the boat would move.

But, notwithstanding the lack of value of the Rochester "test," as an experiment, it does not follow that it was not well worth its cost as an exhibition. The wide publicity which has been given to it will serve to attract the attention of capitalists and of the public generally to a new "application of the forces of nature to the use and convenience of man," and stimulated by this, engineers and electrical firms may go on to solve the practical problem which the Rochester exhibition made no attempt to solve: How much or how little is there in canal-boat propulsion by electricity?

It is worth while to note here the contrast between the attitude of mind of the engineer and the layman in the consideration of this and similar problems. To the engineer the Rochester test was of little or no practical use, for he could have predicted beforehand its results with absolute certainty. It is the multitude of practical questions of detail, which he cannot decide from the data that precedent has furnished, that he requires experiments to settle. The general public, on the other hand, cares nothing for further experiments. The Rochester test proved that a canal-boat would move at good speed when propelled by an electric motor and that is all the public thinks it important to know.

Returning to the engineer's point of view, while there are many doubtful questions in connection with this new use of electricity on canals, its promise is great enough to warrant serious attention from engineers. Of late years the canal-boat and the railway freight car have been having a neck-and-neck race in the carriage of bulk freight, and the former has been generally gaining in the race. Now, there is at least a possibility that the electric motor can effect a material reduction in the cost of moving grain or coal or ore or other bulky products on the canals; and should this possibility become an accomplished fact, it may be of great importance in stimulating the return of bulk freight to the canal routes.

While no exact figure, and hardly an approximate one, can be named for the cost of electric motor propulsion on canals in advance of experiments, a brief consideration of the principal difficulties likely to be encountered, and how they are likely to be met, may be of interest.

The generation of the electric current on canal lines, in the first place, should be comparatively inexpensive, as water power can generally be secured from feeders, waste weirs, etc., along the line of the canal sufficient for its use. On some of the canals in Ohio, Indiana and Illinois, part of the power might have to be generated by steam; but even then the advantage of cheap, water transported, fuel, should reduce the cost of power considerably. It is to be noted that in canal-boat service the variation in power consumption, which is an important cause of loss in street railway service, especially where water power is used, will be very small. On a street car the amount of power absorbed when a car is getting under headway or ascending a steep grade is greatly increased over the average consumption. On a boat there will be no increase of power consumption at starting and the motor will use a constant power while running.

For transmission of power from the central station to the boats along the line it will probably be conceded that a line wire is the most feasible method. The storage battery, which is the alternative, has hardly been mentioned, and probably unless a very great improvement should be made in it in the way of increase of power stored in proportion to weight, it could not hope to compete with the trolley system.

At the Rochester exhibition a double-line wire and two trolleys were used, one carrying the return current; but with the facilities for leading the return current to the earth which the water of the canal offers, it is not apparent why an overhead return should be used when the system is put into regular use. Whether a single line wire could be used with turnouts at short intervals, as in single track street railway lines, is uncertain. Its advantage by saving in first cost and cost of maintenance would be considerable; but on the other hand, canal-boats cannot be moved on regular schedules like street cars, and the delays might make the system impracticable.

For taking the current from the overhead wire, ordinary street car trolley poles were used at Rochester; but this was merely a makeshift, and in practice an overrunning trolley with a flexible cable connection to the boat would naturally be used. What to do with this cable connection at the numerous low bridges which abound over most canals is another question needing careful study. To lead the wires underneath the bridges would put a live and uninsulated wire in easy reach of inquisitive meddlers, and to disconnect the terminals and carry the cable across the bridge by hand would involve the services of an extra man, and might cause more or less frequent delays and accidents.

Coming next to the motor and propeller, it should be a comparatively easy matter to design a motor for this service which would work with high efficiency, would be so simple as to be easily managed by the ordinary canal-boatman, would not be liable to defects or burn-outs, and would be of moderate first cost. Either a single or double reduction gear would naturally be used. The gears could be made large enough and heavy enough to involve small loss of power and permit high speed of the motor, as noise is not a serious objection, and the restrictions as to weight and space which have troubled the designers of street car motors do not obtain here.

The design of the propeller, however, is not so simple a matter, and only extended experiments can definitely settle the questions connected with this. To reduce loss of power in the effluent water, the propeller should be made as large as possible, and should revolve at slow speed. This will probably be desirable also to reduce wave action on the banks. On the other hand, a large propeller will be partly out of water when the boat is light and will then work inefficiently. This difficulty could be partially remedied by the use of twin screws, or entirely by the use of a wholly independent vessel, carrying no load, to act as a tug. In each case, however, it is a question whether the gain in power would be compensated for by the extra cost and added loss of power involved, and experiments alone can furnish a satisfactory answer.

A rough estimate of the power used by the boat tested at Rochester showed about 20 HP., and with the propeller making 60 revolutions per minute it is said that a speed of about four miles per hour was reached, the boat moving against the wind and the current. As the velocity of the latter is not stated, however, the test sheds little light on the consumption of power in proportion to speed. A preliminary step to any determination of the possibilities of electricity for canal service would be a determination of the power absorbed by an ordinary canal-boat when moving at various speeds of from two to six miles per hour. With these figures and with figures for the cost of electrical power at the propeller shaft, the cost of boats, and the cost of their operation, the most economical rate of speed could be readily determined. It is probable that this most economical rate will be lower than is generally assumed. The ordinary rule that the power required increases as the cube of the speed does not apply to such narrow and shallow channels as the ordinary canal prism, the increase being in even greater ratio. But even leaving this out of the account, a variation only as the cube of the speed means that an increase from a speed of four miles per hour to a speed of five miles per hour would increase the power absorbed as $4^3 : 5^3$, or would practically double it. The advantages of electricity on the canals will thus hardly be found in an increase of speed, but in a decrease in the cost of towing, through more economical use of power (which is cheaply obtained in the first instance) through a lessened cost of attendance, and through the reduction in the weight and space required for the propelling machinery.

Comparing the electric motor with animal traction, it can hardly be doubted that the former will have a great advantage. On the Erie canal, however, the steam propeller has already displaced animal traction on a large proportion of the boats.

Comparing steam and electric propulsion, we have the small steam engines used working under very unfavorable conditions, requiring more or less expensive attendance and having a large consumption of fuel per horse power. The electric motor, on the other hand, can work with very small loss, dispenses with the services of the engineer-fireman, the switch controlling its starting and stopping being under charge of the helmsman, and takes up only a fraction of the space occupied by the engine and boiler.

It is worth while noting in this connection that if the subject is to be thoroughly investigated, the possibilities ought to be determined in the use of overhead cable traction, the cable serving at once to transmit the electric current and to carry a gripping trolley on which the electric motor would be nominal; and the boat would be pulled by a rope from the trolley. This system would dispense entirely with the use of propellers in the canal, with their attendant wash, and more or less waste of power. Such a plant would, of course, be much more expensive in first cost than the trolley system which appears to be at present contemplated, but it offers some inviting possibilities in the way of economizing power, and increasing the convenience of its application.

LETTERS TO THE EDITOR.

COMPUTING SHEAR FROM UNIFORM LOADING.

Sir: To my inquiry in Engineering News of Sept. 7 I have received replies from Mr. William W. Crehore and Fr. von E. (dated Sept. 21), referring me respectively to Professor Du Bois' "Strains in Framed Structures," and to Professor Winkler's "Brueckenbau."

The diagram in the issue of Sept. 7 shows, as plainly indicated, the equivalent uniform load "g" as a function of the variable distance "l." A certain system of concentrated loads which is assumed to have advanced from the right hand end of the span so far as to make the distance from the first load to the right hand end of the span equal to "l," and a uniform load, equal to "g" per lineal unit, extending over the same distance "l" are to cause the same shear at the left of the distance "l." This is the condition for the value of "g." For brevity's sake, I shall call "g" the equivalent load and "l" the advance.

In accordance with the law cited in the issue of Sept. 7, the equivalent load is a function of the character of the system of concentrated loads and the advance, but independent of the length of the span. Consequently the diagram is good for any advance and any span; it gives at a glance the value of the equivalent load for any length of span and any position of the system of concentrated loads on the span. I shall call this diagram briefly the universal diagram of equivalent loads.

The values of "g" are obtained from the formula:

$$g = \frac{2 \times \sum\limits_{1}^{n} W \times d}{l^2} \qquad \ldots\ldots \ldots\ldots (1)$$

$W_1, W_2, W_3, \ldots W_n$, being the concentrated loads on the span; $d_1, d_2, d_3, \ldots d_n$ being their distances from the right hand end of the span; and l the advance.

The numerical values of g are found most easily by means of the grapho-static interpretation of the formula (1). The diagram of the values of g as a function of l corresponding to the formula (1) is strictly speaking no curve, but a chain of curves.

I shall illustrate the practical use of the universal diagram of equivalent loads by three examples.

All loads and values of the shear are given for one rail in tons of 2,000 lbs., and all calculations are made with the slide rule.

(1). Suppose a train of the New York, West Shore & Buffalo Ry. (original, two 81-ton engines) to have advanced 70 ft. on a 90-ft. plate girder span. The universal diagram gives for l = 70 ft. (first axle in the lead) the value g = 0.83 tons per lin. ft. Introducing this value of g in the formula for shear S from a uniform load equal to g per lin. ft:

$$S = \frac{l^2}{2\,L} \times g \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

L signifying the length of the span, we have

$$S = \frac{70 \times 70}{2 \times 90} \times 0.83 = 22.6 \text{ tons.}$$

To find the maximum shear for a point of the span 70 ft. distant from the right hand end of the span we place the first, second and third axle consecutively over this point, and ascertain the values of the corresponding shear S_1, S_2 and S_3, as follows:

We have found

$$S_1 = 22.6 \text{ tons.}$$

The values of S_2 and S_3 are:

$$S_2 = \frac{78 \times 78}{2 \times 90} \times 0.83 - 3.8 = 24.2 \text{ tons.}$$

$$S_3 = \frac{84 \times 84}{2 \times 90} \times 0.82 - 9.3 = 22.8 \text{ tons.}$$

3.8 and 9.3 are the loads at the left of the point for which the maximum is to be found.

Hence max. S = 24.2 tons.

(2). Suppose the head engine of the train chosen for the first example to have advanced on a 20-ft. span so far as to bring the second axle over the left hand support. The universal diagram gives for l = 20 ft. (second axle in the lead) the corresponding g = 1.37 tons per lin. ft. Introducing this value of g in the formula for reaction "R" at the left hand support

$$R = \frac{L}{2} \times g \ldots\ldots \ldots \ldots\ldots\ldots (3)$$

L signifying the span, we have

$$R = \frac{20}{2} \times 1.37 = 13.7 \text{ tons.}$$

(3). Suppose a train of the Cincinnati Southern (old C. S., two 66-ton engines, 1-ton train) to have advanced on a 242 ft. trussed span (11 panels of 22 ft.) within panel No. 8, numbering the panels from right to left. To cause the maximum shear from uniform load in panel No. P, the uniform load must have advanced into this panel so far that the part a of the panel covered with load corresponds with the formula

$$a = \frac{(P - 1)}{(T - 1)} \times p \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

T = total number of panels.

p = panel length.

For P = 8, T = 11 and p = 22 ft.

We find

$$a = \frac{7}{10} \times 22 = 15.4 \text{ ft.}$$

The advance l for the 242 ft. span to cause a maximum shear in panel No. 8 is consequently

$$l = 7 \times 22 + 15.4 = 169.4 \text{ ft.}$$

The universal diagram gives for l = 170 ft. (first axle in the lead) the value g = 0.65 ton per lin ft. Introducing this value of g in the formula for the maximum shear S in panel No. P

$$S = (P - 1) \times \frac{a}{2} \times g \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

We have

$$S = 7 \times \frac{15.4}{2} \times 0.65 = 35.0 \text{ tons.}$$

In Table I. S is the maximum shear obtained by means of formula (5) and the universal diagram. "S." is the maximum shear as found when treating the train as a system of concentrated loads by graphostatics.

TABLE I.

Old Cincinnati Southern Train.

P =	4	5	6	7	8	9	10	11
g =	0.71	0.70	0.69	0.67	0.65	0.64	0.63	0.62
S =	7.0	12.3	19.0	26.4	35.0	45.0	56.1	68.2
S =	7.2	12.5	19.2	27.0	35.5	45.0	56.2	68.5

Table II. gives the corresponding values for a New York, West Shore & Buffalo train (original, two 81-ton engines, 1.12 ton train) for the same 242 ft. span.

TABLE II.

New York, West Shore & Buffalo Train.

P =	4	5	6	7	8	9	10	11
g =	0.83	0.82	0.81	0.79	0.77	0.75	0.73	0.72
S =	8.2	14.4	22.2	31.3	41.5	52.8	65.0	79.2
S (g) =	7.7	14.1	21.8	30.8	41.1	52.3	64.7	78.7

In conclusion I will say that I do not agree with the communications in the issue of Sept. 21 by Mr William W. Crehore and Fr. von E. Neither Professor Du Bois' "Strains in Framed Structures," nor Professor Winkler's "Brueckenbau" states the law cited by me in the issue of Sept. 7, nor does either one give the formula for g as f (l), nor the universal diagram of equivalent loads as represented in the issue of Sept. 7, nor does either one suggest the method of obtaining the shear by means of a universal diagram.

Professor Winkler assumes, in constructing his diagrams, $\frac{l}{L}$ to be a constant. He thereby obtains the equivalent load as function of L. He offers as examples the diagrams for $\frac{l}{L} = 0.5$ and $\frac{l}{L} = 1.0$. They show g as function of L, not of l. He is not aware that g is independent of L.

Yours truly, William F. Waag.

St. Louis, Mo., Oct. 14, 1893.

TRANSITION CURVES.—BOROUGH CORRECTION.

Sir: I notice in recent issues inquiries relative to tables for running transition curves. In the Michigan Engineers' Annuals for 1891 and 1892 is a full discussion of the subject by Col. E. W. Muenscher; and he gives his method of locating the curve (cubic parabola) without the use of any tables whatever except some very short and simple ones, which are easily carried in the head. It is as easy as to run the circular curve.

I also notice various communications relative to difference of measurements of land in cities. I think it is a well-established principle of the common law that the measurements as well as the monuments of the survey in accordance with which the land was originally sold are the controlling measurements. In the case of the United States surveys this principle is made a part of the national statute. Numerous decisions of the courts to this effect are quoted in my "Manual of Land Surveying." F. Hodgman.

Climax, Mich., Oct. 30, 1893.

BOROUGH CORRECTION.

Sir: In your issue of Oct. 19, "Borough Correction," the question of the disposition of excess in the lengths of blocks of cities, is discussed. My practice, which has stood the tests of the courts, is based on Congressional legislation, which is:

(1) "That the boundaries of the public lands, established and returned by the duly appointed government surveyors, when approved by the surveyors-general, and accepted by the government, are UNCHANGEABLE."

(2) "That the original township, section and quarter section corners, established by the government surveyors, must stand as the true corners which they are intended to represent, whether the corners are in place or not."

Now in the case of surveys of lots in a block, the street lines are the boundaries of the block, and the width of any lot will be the distance between these boundaries, divided by the number of lots.

Yours truly, Wm. Tweeddale.

Topeka, Kan., Oct. 28, 1893.

DUTY OF DUPLEX PUMPS.

Sir: Your correspondent E. Y. W., in his article headed "Bids for Providence Pumping Engines," in your issue of Nov. 16, states that duplex pumps never accomplish what they are supposed to do, etc., etc. The young man is very much mistaken. I will agree with him that the duplex pumps, as he might have seen and handled them, and as they are built by other makers than myself, do act as he states, as a natural consequence where one engine is the custodian of the main valve of its neighbor, and vice versa. I however, build a duplex pump that makes its stroke every time, neither lengthens nor shortens under any conditions; but I use a supplemental valve which is controlled by the opposite engine, this device permitting me to close down one engine and run only one side or one-half of my duplex plant, or the two engines can be run as single. This device also avoids the necessity of the services of a "wet nurse" around a pump at a trial or the necessity of jockeying a duty test, and thus obtaining at said duty trial what cannot be obtained (as stated by E. Y. W.) at any other time in the hands of the average machinist. I would be most happy to meet E. Y. W. at my works and show him that there is one duplex pump made that does make its stroke, that will not exceed it nor strike cylinder heads, and would also show him a live machine that has been doing this same work just 10 years, 24 hours a day, under a head of 200 ft.

Very truly yours, M. T. Davidson,

Brooklyn, N. Y., Nov. 18, 1893.

AS TO M'GILL UNIVERSITY—CORRECTION.

Sir: In your issue of 9th inst. you are pleased to call our celebrated university an American engineering school. How proud you would be could you rightfully claim it! I take exception to your statement, and I wish you and all others to understand that McGill University is purely Canadian. In its method of working, teaching and all else, there is nothing about it to shew the slightest indication that it is American. It is also self-supporting, or if it has received any aid from Americans it is only in tuition fees paid by the Yankee boys when they come over here to be educated. Yours, E. Berryman.

Sherbrooke, P. Q., Nov. 16, 1893.

(The expression to which exception is taken was this: "McGill University is a very live institution, and since these additions have been made to its plant for instruction in engineering it stands in the front rank of American engineering schools." We strive to please; and after having been taken to task some years ago by another Canadian for speaking of "Americans" as if only natives of the United States were properly to be included under that name, and with some geographical justice, as we thought, have carefully avoided denying to Canada and Canadians the right to be considered as American also. Logically, however, we agree with our correspondent that they should not be, because of a mere geographical accident, saddled with a name which they neither desire nor deserve to have thrust upon them.—Ed.)

A USEFUL NOTE ON "UNEXPLAINED" MAGNETIC VARIATION.

Sir: While running out the magnetic bearings according to an old deed at this station, I discovered an unsuspected cause of error in reading the needle of the transit. Noticing a movement of the needle when I changed my position from side to front of instrument, I investigated the cause and found it to be the small stiffening piece in the point of my necktie. It is only 3½ ins. long, ¼ in. wide and 1-50 in. thick, but it has more effect on the needle than a 100-ft. steel tape or a hatchet at the same distance. As it is covered with paper, it is innocent looking enough; but it obliged us to spend half a day in correcting our work.

I send the little piece inclosed. It is evidently magnetized steel. When one end was held close to the box, it moved the needle through 90°. The similar piece in each of a dozen other neckties had no effect or moved the needle only one or two degrees.

Very truly yours, Edward P. Adams,
L. H. Surveyor, 1st and 2d Dists.

Stockton Springs, Me., Oct. 30, 1893.

(Our correspondent has suggested a possible cause of very serious error in reading magnetic needles which we have never heard alluded to before, but which has doubtless been the cause of many unexplained and unsuspected errors in needle bearings. The moral would seem to be: Tie your own necktie or wear none when out on survey.—Ed.)

SOARING POWER OF BIRDS.

Sir: A recent letter from Mr. Wellington to myself contained a concise statement, arranged under 13 heads, of his theory of soaring flight, with the request that I should write a reply to each head. This has been done, and with Mr. Wellington's sanction notice is hereby given that copies of both documents will be mailed to any applicant who will send to the undersigned his address and four cents in stamps. I. P. Church.

Ithaca, N. Y., Nov. 20, 1893.

(In the judgment of the editor he was not warranted by the general interest in the subject in publishing the above documents in addition to Professor Church's last letter, published in our issue of 16th inst., but this offer of Professor Church affords opportunity for those who are really interested in the subject to consider it further. As we have previously announced, our columns are still open for the presentation of experimental evidence, or for theories stated to be based on actual observation and study of soaring birds in action; but not for further abstract discussion of theories as such, not based on comparison with observed facts.—Ed.)

MOVEMENT OF THE PHILADELPHIA CITY HALL TOWER.

Sir: Mr. Neville B. Craig, in his letter on "Movement of Towers Due to the Heat of the Sun," published in Engineering News of Nov. 16, refers to my paper on "The Tower of the New City Hall at Philadelphia," read before the American Society of Civil Engineers, and says that I find that the top of our City Hall tower is wriggling around like a tree top in a storm, changing its position anywhere from 5 to 9 ins. under the varying effect of the sun's heat.

With regard to this, I wish to state that I did not deduce any conclusions whatever from the record of movements of the tower, still less did I find a change of its position varying from 5 to 9 ins. This record, which is owned by the city of Philadelphia, has been handed over to me, and I gave it for what it is worth. Every reader can draw his own conclusions from the same. Respectfully yours, C. R. Grimm.

Tacony, Philadelphia, Pa., Nov. 20, 1893.

AUSTRALIAN IRONBARK.

Sir: In reference to a paragraph on ironbark timber in your last issue I would say that the white ironbark is Eucalyptus crebra (not paniculata), and the red ironbark is either Eucalyptus paniculata, or Eucalyptus leucoxylon, depending on the locality or soil from which it is obtained. The Eucalyptus siderophloia is a Queensland ironbark and inferior to those of New South Wales. No ironbark grows in Victoria, South Australia, or Western Australia. The botanical name is never used in the timber trade.

In regard to your article (Oct. 19) on timber and iron bridges in New South Wales I may add that the prices of both the iron and timber designs for Cowra were loaded with $21 per ton for railway carriage, as not only the ironwork, but all the timbers had to be forwarded via Sydney, there being no suitable local timber. Timber bridges in the timber districts cost about 65 cts. to 90 cts. per cu. ft., depending on the type of bridge. In the last paragraph of your article the price per pound for the ironwork erected in situ should be 7 cts., not 11 cts. per lb. The prices given by me in the Parliamentary report referred to may be taken as fairly correct, for when tenders were invited the lowest tender was $121,556, as against my estimate of $128,178. The contract prices (exclusive of inland carriage) were: Cast iron in cylinder piers, $55 per ton, and steel in superstructure, $105 per ton, free on wharf in Sydney, New South Wales. This bridge was completed and opened for traffic about two months ago, and is the largest composite bridge in the Australian colonies.

Local timber is also very largely used for wood paving, and costs about $3 per sq. yd. laid, but exclusive of concrete foundations. The timber used for this purpose is preferably tallow-wood (Eucalyptus microcorys) or blackbutt (Eucalyptus pilularis). For decking highway bridges the New South Wales tallow-wood is without an equal.

I inclose a cutting from a late Sydney "Mail," by Mr. Maiden, Consulting Botanist to the New South Wales Forestry Department, on Australian timbers, which might be of interest to your readers.

Very truly yours,
John A. McDonald, M. Am. Soc. C. E.

New York, Nov. 18, 1893.

(The paragraph first referred to had for its basis a paper on ironbarks, read before the Sydney Architectural Association, by Mr. J. H. Maiden, and published in the Sydney "Building and Engineering Journal." The botanical names were there given, as stated by us, but we are indebted to Mr. McDonald for the correction.)

METHOD OF FINDING THE SUPERELEVATION FOR RAILS ON CURVES.

Sir: Some of the readers of your valuable paper may find of interest, and perhaps of practical value, the following adaptation of the graphical method in the solution of a railway problem. It was given by Prof. A. von Kaven, Director of the Polytechnic School at Aachen, Germany, while the writer was there as a student.

For any railway curve, even if the radius of the curve be unknown, or if the curve be formed from different radii, as, for instance, in transition curves, the elevation of the outer rail may be expressed as function of the velocity of the moving train, and as versed sine of a chord drawn on the inner rail of the curve. The length of this chord can be so chosen that the versed sine shall equal the required elevation of the outer rail for any accepted velocity of the moving train when passing over the curve.

Let length of chord l = velocity of train in feet per second.

d = versed sine of chord l.

s = gage of railway.

v = velocity of train in feet per second.

r = radius of the curve.

h = required elevation of outer rail.

g = 32.2 ft. acceleration of falling bodies.

The equation for h will be, as is well known:

$$h = \frac{s\,v^2}{g\,r} \quad \text{(a)}$$

In the equation of the circle, approximately, and near enough for our purpose:

$$r = \frac{l^2}{8\,d} \quad \text{(b)}$$

Therefore, when this value of r is substituted in equation (a),

$$h = \frac{8\,s\,v^2}{g\,l^2} \times d,$$

and, as h shall equal d in our problem,

$$\frac{8\,s\,v^2}{g\,l^2} = 1;$$

$$l^2 = \frac{8\,s\,v^2}{g}.$$

For $g = 32.2$, $l^2 = 0.248447\,s\,v^2$

$$l = 0.498\,v\,\sqrt{s}.$$

For $s = 4.7$, the ordinary gage of railways.

$$l = 1.0796\,v,$$

or approximately, and near enough,

$$l = v.$$

Therefore, if one draws on the inner rail of a railway curve a chord which in length equals the velocity of the moving train in feet per second, the versed sine (d) will equal the required elevation of the outer rail of that curve. Yours respectfully,
Orville Fisher.

Providence, R. I., Nov. 15, 1893.

RAPIDITY OF MOVEMENTS IN ELECTRO-PNEUMATIC INTERLOCKING.

Sir: In the description of the interlocking plant at Stewart Ave. and Twenty-first St., Chicago, on page 390 of your issue of Nov. 16, the following passage occurs:

> The dispatch with which a route can be arranged for a train may be illustrated by taking a regular Santa Fe passenger train running to Dearborn station. If such a train shows up, and all the switches are in normal position, the leverman has to throw 5 movable point frogs, 4 single switches, 5 double-slip switches and give 2 signals. This he does by moving 9 of the levers and accomplishes the work in 16 seconds. In a manual interlocking machine he would have thrown 23 levers and worked hard to have finished in 70 seconds.

The estimate of time which is required to move 4 single switches, 5 double-slips, 5 movable frogs and 2 signals with the electro-pneumatic interlocking seems to us excessive, from the fact that at Jersey City 11 levers have been moved in 6 seconds on one occasion and in 4 seconds on another occasion. We believe, therefore, that the levermen at Stewart Ave. will be enabled to reduce this time by more than one-half after they have had more experience, and will gradually reach double the speed, if not more, that they are now able to secure.

The Union Switch & Signal Co.

DEVICE FOR RECORDING BRIDGE VIBRATION.

Sir: Mr. Noonan, in his communication Nov. 9, asks for information as to who has done any work in recording bridge deflections or vibrations. The writer, while a member of the Engineering Society of Lehigh University, did a little investigation under the following circumstances, in October of 1891. The New St. bridge, of Bethlehem, Pa., across the Lehigh River, consisted of a number of land and river spans. They were all of light design, Pratt combination iron and wood, and were doing more work than they were designed to do. One land span of 90 ft. seemed, to foot passengers, particularly susceptible to vibration. The writer constructed a simple piece of apparatus to record the vibrations of this span under the different loads. The apparatus had a T-shaped base, with a leveling leg in each point of the T. On the long leg of the base was fastened a vertical piece carrying guides for a ¼-in. strip 4 ins. wide and 3 ft. long, so arranged as to move horizontally by means of a thread wound once or twice around a spool, the two ends being attached to either end of the long strip. This strip carried the paper which was to receive the vibrations. The vibrations were transmitted to the paper by means of a pencil inserted in an iron box at the end of a fine steel wire which was attached to the end of the center floor beam of the bridge. The box containing the pencil was guided vertically by means of small iron pins bent over at the ends so as to inclose the bar and prevent it moving away from the paper. The vertical motion given to the bar by the vibration of the bridge was continuously recorded by moving the strip, carrying the paper, slowly along by means of a small crank attached to the spool. The paper was moved as the load came onto the bridge and stopped when it had passed off. The paper was supposed to be moved uniformly, but as a check the pencil was stopped when the load was on the center, to produce a heavier mark at that point. The greatest vibration recorded was due to a team and wagonload of brick; it was about one panel length beyond the center and was 1⅛ in.

F. A. Coleman.
Jun. Am. Soc. C. E.

Cleveland, O., Nov. 14, 1893.

NOTES AND QUERIES.

R. M., of Brooklyn, is informed that the address of Mr. Geo. H. Johnson is 2732 Pine St., St. Louis, Mo.

NOTES ON MACHINERY OF THE NEW VESSELS OF THE UNITED STATES NAVY.*

By Geo. W. Melville, Engineer-in-Chief U. S. N.

The building of our new navy began, of course, with what are known as the Roach cruisers, the "Chicago," "Boston," "Atlanta" and "Dolphin," in 1883. The earliest of our new ships were gunboats and protected cruisers and in order to get the machinery below the protective deck the engines were of the horizontal type. Later, when the idea of fitting the vertical armor around the cylinders had been advanced, thus enabling vertical engines to be used, we adopted them and have faithfully adhered to them, except in the single case of the ram "Katahdin," where the circumstances of the case were such as to compel the use of horizontal engines. I ought to say, however, that our engines all come below the protective deck, so that no vertical armor is used, as is the case in England.

It is hardly necessary for me to point out in such a meeting as this the advantages of the vertical engine over the horizontal, although I would, by no means, give the impression that our horizontal engines are otherwise than very satisfactory. Indeed, the long cruises made by such vessels as the "Philadelphia," "Yorktown," "Baltimore" and "San Francisco," leaving the machinery in admirable condition, show that these horizontal engines were very satisfactory.

Plans for Economizing Coal at Ordinary Cruising Speeds.

In the old days, where the maximum speed was perhaps 12 knots, it was a very easy matter to run at 8 knots with at least the same and probably greater economy than at full power; but in our modern ships, built to make 18 and 20 knots, it is a very different thing to reduce the speed to 10 knots. The friction alone of moving the immense pistons and other moving parts of the 16,000-HP. engine when it is developing perhaps only 1,500 HP. deducts a very large amount from the gross horse power and leaves the net a very small fraction. Besides the matter of friction there is to be taken account of the immense cylinder condensation in these large engines running at greatly reduced power and with high grades of expansion. This would reduce the economy very decidedly.

Various methods have been attempted to solve this problem, perhaps the earliest of which was the idea of having two sets of engines on the same shaft, one of which could be thrown out at reduced powers. This was first done, as far as I now remember, in the Italian battle-ships "Italia" and "Lepanto," but has been since repeated in numerous others and is used in our own vessels, the "New York" and "Brooklyn." Another method, which naturally suggested itself when the number of cylinders was multiplied in the adoption of the triple-expansion engine, was the cutting out of the low-pressure cylinder at reduced powers and running as a compound engine with the two smaller cylinders of the original triple expansion engines. This would then work up to somewhere near the full power of the cylinders of that size with a reduced pressure, so that, while not nearly as economical as well-designed triple expansion engines for the power which was actually being used, it would, nevertheless, be more economical than the large triple expansion engines workiing at very much reduced power. This method we have adopted on our armored cruiser, the "Maine," and I believe it is in use on a Russian cruiser and some other vessels.

The next method which suggested itself is the subdividing of the very large power among three engines instead of two, giving us the triple screw ship, so that at very low speeds only the central engine need be used, the propellers of the side engines being disconnected and allowed to revolve freely. Of course, in this case there is the loss due to the work necessary to drag these propellers through the water, and to offset this is the gain from saving the friction of running two large engines in a twin-screw ship. The experiments by Chief Engineer Isherwood, at the Mare Island Navy Yard in 1874, on the power necessary to turn screw propellers, when disconnected and allowed to revolve freely, show that the loss in this way is very slight, and there can be little doubt that this will by no means be equal to the power which would be absorbed in the friction of the large moving parts of two large engines. Then, as has already been pointed out, we shall have a single engine working up to pretty nearly its full power, when the steam economy would be good, while in the case of the two large engines working at very reduced powers the steam economy reduced by condensation would be very low. The first of our triple screw cruisers, the "Columbia," has just had her official trials, which have been a great success as far as working at maximum power is concerned. Of course, there has been no opportunity yet to determine the economy of working at reduced powers by the use of a single screw, but by a study of the logs of the "New York" and the "Columbia" for a couple of years we shall be able to form a very clear idea as to which of these methods is the better one for economy.

Still another very ingenious method of combining an engine which shall be fairly economical at full power with one which shall have good economy at moderate powers is the engine which we have just designed to go in Gunboat No. 7 of our navy. The primary conception of this idea is due to Professor Hollis, of Harvard University, until recently one of my assistants in the Bureau of Steam Engineering, and the subsequent working out has been under my direction and modified to suit all the circumstances of the case.

In this case it was desired to combine as many desirable features as possible, so that the machinery was not only to be economical, but to be very light. With this latter end in view, more than two-thirds of the boiler power is in the shape of tubulous boilers, whose weight, as is well known, is, roughly speaking, only half that of the ordinary cylindrical boiler. The special novelty in the design consists in having the engine designed as a quadruple expansion engine for full power, taking steam to the high-pressure cylinders from the coil boilers, while the remainder of the boiler power, which consists of two cylindrical boilers, will furnish steam to the first receiver, a reducing valve being fitted so that the pressure in the receiver will be just equal to the pressure of the steam discharged from the high-pressure cylinder. Of course, while this is entirely novel, it is really an extension of the idea which has obtained for some time of exhausting from the auxiliaries into the receivers.

At reduced powers the engines will be made triple expansion by disconnecting the large low-pressure cylinders, leaving the triple expansion engines composed of the three smaller ones; and the cylinders have been designed so that they have good proportions for economical working as a triple expansion engine with steam at 160 lbs. The cylindrical boilers are designed to furnish steam at this pressure, while the coil boilers will furnish to the high-pressure cylinders of the quadruple expansion engine steam at 250 lbs. pressure. Naturally they can also work at reduced pressures, so that either of the cylindrical boilers or any of the coil boilers may be used to furnish steam for the triple expansion engine at moderate speeds.

Table Showing Expenditures of Coal on U. S. S. "Charleston" at Various Speeds.

Speed, knots per hr.	Ind. HP. main eng's.	Lbs. coal per I. H. P.	Indicated H. P. of auxiliaries. Air pump.	Circ. pump.	Feed pump.	Blower.	Bilge pump.	Other auxiliaries.	Total.	Lbs. coal per I. H. P. auxiliari's.	Total coal used per hr., lbs. Auxiliaries.	Radiation, etc.	Distilling, etc.	Main engines.	Total per hour.	Tons coal per day.	Coal, tons per day increased 3 tons.	Knots per ton of tot'l consum'n.	P. c. of coal expend'd on main engines.
4	107	4.0	23.7	19.4	2.5	0.	6.9	26.5	79.0	6	474	375	100	428	1,377	14.75	17.75	5.41	31.1
5	180	3.5	23.9	20.1	2.8	0.	6.9	26.5	80.2	6	481	375	100	630	1,586	16.99	19.99	6.00	39.8
6	270	3.25	24.2	20.8	3.1	0.	6.9	26.5	81.5	6	489	375	100	878	1,842	19.76	22.76	6.33	47.3
7	380	3.0	24.6	21.7	3.6	0.	6.9	26.5	83.3	6	499	375	100	1,140	2,114	22.65	25.65	6.55	53.9
8	520	2.8	25.1	23.2	4.2	0.	6.9	26.5	85.9	6	515	375	100	1,456	2,446	26.22	29.22	6.57	59.5
9	700	2.6	25.7	21.6	5.0	0.	6.9	26.5	88.7	6	532	375	100	1,820	2,827	30.30	33.30	6.48	64.4
10	960	2.5	26.5	27.3	6.2	0.	6.9	26.5	93.4	6	560	500	100	2,400	3,560	38.13	41.13	5.83	67.4
11	1,290	2.4	27.6	30.6	7.5	0.	6.9	26.5	99.1	6	595	500	100	3,096	4,291	45.96	48.96	5.39	72.1
12	1,710	2.3	29.0	35.9	9.3	0.	6.9	26.5	107.6	6	646	625	100	3,933	5,304	56.79	59.79	4.82	74.1
13	2,220	2.2	30.7	41.1	11.4	0.	6.9	26.5	116.6	6	700	750	100	4,884	6,434	68.94	71.94	4.34	75.9
14	2,820	2.1	32.7	47.5	14.0	2.5	6.9	26.5	130.1	6	781	750	100	5,922	7,553	80.94	83.94	4.00	78.3
15	3,550	2.0	35.2	58.0	17.1	6.4	6.9	26.5	150.1	6	901	750	100	7,100	8,851	94.83	97.83	3.68	80.2
16	4,370	1.9	37.9	70.0	20.6	17.6	6.9	26.5	179.5	6	1,077	750	100	8,303	10,230	109.62	112.62	3.41	81.2
17	5,220	2.1	40.7	84.8	24.0	36.8	6.9	26.5	219.7	6	1,318	750	100	10,962	13,130	140.68	143.68	2.84	83.5
18	6,120	2.5	43.7	114.0	28.0	69.6	6.9	26.5	288.7	6	1,732	750	100	15,300	17,882	191.60	194.60	2.22	85.5

Coal Consumption of Auxiliary Engines.

Doubtless, we have all thought of the fact that the multiplication of auxiliaries, independently of the main engine on board ship, has involved considerable steam consumption which was not applied directly to propulsion, but, so far as I am aware, the matter had never been considered in great detail until Professor Hollis, then a Passed Assistant Engineer in the Navy, discussed it about a year ago in some lectures he delivered at the Naval War College. I have inserted a table which he gives, based on the performance of machinery with which he had had personal experience, showing the percentage of steam developed by the boilers applied to propulsion and to auxiliaries at various speeds, and you will notice at a glance that, at low powers, the proportion expended in auxiliaries is very large. This, of course, has a very material effect on the economical speed and the steaming radius. In fact, it vitiates entirely the theoretical calculations which are made for radius of action by simply taking the horse power of the main engine at various speeds, and allotting a certain coal consumption for each horse power, and then working out from the bunker capacity. For one of our ships, where the radius of action has been computed at about 25,000 knots at a speed of 10 knots, I had the calculation more carefully made, allowance being made for steam for the auxiliaries, and I found that in reality the steaming radius would probably not exceed 11,000 knots.

In this connection it is well to note a matter which has already been discussed a good deal recently in regard to the desirability of detaching all the auxiliaries from the main engine. As we all remember very well, 20 years ago, all the pumps were driven from the main engine. Then, as speeds increased, one pump after another was disconnected from the main engine until finally it was left with nothing to do except to turn the propeller, and as far as smooth working is concerned, nothing more could be desired. Now it is a question of economy that confronts us, and we are driven to consider whether we have done wisely in driving pumps by simple engines, which are very wasteful in steam, instead of from the main engine, which, when well designed and properly managed, is vastly more economical. The relative expenditure of steam in the two types is shown by the fact that some feed-pumps, which were carefully tested, took 120 lbs. of steam per HP., while even in our naval engines, which are not as economical as the best merchant engines, we probably get a horse power from about 20 lbs. of steam.

At the recent meeting of the International Engineering Congress at Chicago, Mr. Dickie, of the Union Iron Works, made a very strong presentation of the case for making the air-pump an integral part of the design of the main engine, and I would prefer those of you who care to go into this matter at length to his excellent paper. He has given the matter careful consideration, and believes that by a judicious design the air-pump can be made to work at any speeds likely to occur with large engines with as great efficiency as when worked independently, and, of course, with a vast increase of economy.

This leads me to speak of a design recently prepared by one of my assistants, Passed Assistant Engineer Frank H. Bailey, U. S. N., of an air-pump specially designed to be run from the main engine of torpedo boats and other fast running engines. This pump has already been tested, and under adverse circumstances gave a vacuum of 21 ins., at a speed of 1,000 revs. per minute. This speed is higher than anything that has yet been attempted, although we are now building some torpedo launches which are to run at a speed of nearly 700 revs. per minute. These boats will have Mr. Bailey's air-pump.

Economizing Weight and Space by Forced Draft.

Thus far I have dwelt principally on the matter of steam economy in our engines as modifying the types and arrangement of cylinders, but I want now to speak with regard to another point, which has, in recent years, become of primary importance, namely, weight and space. Modern machinery which does not give at least 10 HP. per ton is considered behind the age, and, as we all know, in torpedo-boat machinery the figures run very much higher than this, to as much as 40 HP. per ton. I think we are all agreed that as long as the demand for reduction of weight is made in a reasonable way every one should accede to it, because manifestly, if we could cut our weights in half for the same power, there would be that much more weight available to be put into guns, or armor or coal for a man-of-war, or into paying freight for the merchantman. It is a question in my mind whether the demand in the past has not sometimes been slightly unreasonable and led to rather unfortunate results, but I am glad to say that in our own service we have been entirely free from any such misfortunes.

The boilers have always been the heaviest part of the machinery, and here naturally the greatest efforts have been made to reduce weight. The one with which we have all become so familiar in the last 10 or 15 years has been forced draft. It seems somewhat odd that we should in effect have followed the lead of our English neighbors in the last introduction of forced draft, when, as a matter of fact, the famous Colonel Stevens introduced it in the early part of this century, and it has been in use for years on the steamboats on the Hudson. Then, too, during our late war, Engineer-in-Chief Isherwood built 19 gunboats of the "Chippewa" class, which were also fitted with ashpit forced draft. In any case, the practice had fallen into disuse until it was finally reintroduced by the torpedo-boat builders and then taken up by the English naval authorities. Since then, every navy in the world has gone in for forced draft, and to some extent it has been applied in the merchant service also, and, in fact, bids fair to become pretty generally used.

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*Slightly condensed from a paper read at the New York meeting of the Society of Naval Architects and Marine Engineers. Copyrighted, 1893. Published by permission of the Society.

I am a firm believer in the benefits of forced draft when intelligently applied, and have no patience with the people who blow hot and blow cold on the subject (as I have unfortunately been compelled to experience during the last 10 years) who, because an accident occasionally happens with forced draft, immediately say that it is an invention of the evil one, and that it ought to be abolished altogether. The same line of argument would probably prevent our using any modern methods in any line of work.

As between the two methods of forced draft in most common use, that by closed firerooms and by closed ashpits, I am decidedly in favor of the latter when it can be applied. I make this proviso for the reason that some may at once ask why, if I am a believer in ashpit forced draft, nearly all of our large vessels recently designed have forced draft on the closed fireroom system. It is simply because in a war vessel, with a protective deck and minute water-tight subdivision, it is extremely difficult, where there is a number of large boilers, to so arrange the blowers for closed ashpit forced draft as to ventilate the fireroom thoroughly. This is a point which is sometimes forgotten, but if it is, the fireroom would simply become intolerably hot, and while the boilers themselves will work admirably, the men will simply be killed by the heat. The "San Francisco," of our navy, has ashpit forced draft, and all who have had experience on her and on other vessels speak in the highest terms of praise of the greater facility, convenience and comfort which attends this method.

It is to be noted, also, with this method of forced draft, that when there is any care at all taken in the fireroom to keep the grate bars covered, leaky tubes in the combustion chamber are unknown, while with the closed fireroom forced draft they are not at all uncommon.

High Smoke Pipes.

I shall forego the temptation to dwell on this matter of leaky tubes, merely saying that we have been very fortunate in escaping almost entirely every trouble of this kind, which I attribute, in a large degree, to the fact that we have not attempted to get too much work out of our boilers, and will pass on to speak of another method of forced draft, which is very old, but which has only been used on board ship within the last year or two. I refer to the matter of high smoke pipes. Tall chimneys are the most common method on shore for getting a strong draft, but prejudice or conservatism has until recently prevented the application of this practice to use on board ship. The Messrs. Denny, of Scotland, well known for their enterprise in all matters relating to shipbuilding, were the first to call prominent attention to this matter by a vessel built by them called the "Scot," which had smoke pipes 120 ft. high above the grate and no other attempt to force the draft. I do not know that any accurate experiments have been made with smoke pipes of steamers to determine just what the increase in draft is for each increase in height, but it has been repeatedly stated that, roughly speaking, we may assume 10 ft. of additional height to be equivalent to an additional $\frac{1}{8}$ in. of air pressure. It can readily be seen, therefore, what a benefit an additional 40 ft. of height would be.

Taking the suggestion made by the "Scot," when we were designing the "Brooklyn" and the "Iowa," I asked to have the smoke pipes made 100 ft. high, in which I was heartily seconded by the Chief Constructor of the Navy; but it will perhaps surprise you to learn that our professional opinions recommending this matter came very near being overturned by the artistic sense of a gentleman in the Navy Department who was entirely ignorant of technical matters, but who thought that the vessel's appearance would be spoiled by these high smoke pipes. He so represented the matter to the Secretary that the latter required me to submit the reasons why I desired to use these high smoke pipes. As showing the general feeling on this subject, I need only call attention to the fact that the "Campania" and "Lucania" have smoke pipes 130 ft. high, and no other method of forced draft, and I may say that all our new vessels are now being built with pipes of much greater height than formerly obtained.

Another method of forced draft which is now coming into vogue is that known as induced draft, where, instead of closing in the fire room or the ash pit and forcing air in, the products of combustion are exhausted from the chimney by large fans. Of course, this is only another way of getting the same effect that we get by the use of the steam jet and with which we have all been familiar for many years, the advantages in this case being that there is no loss of fresh water, which is a precious commodity on board ship. At a hasty glance, one would not be prepared to expect very much from this method, but the experiments which have been making for some years past in England by Messrs. John Brown & Co. seem to show that this method is very promising, and I understand it is to be fitted to some or all of the large vessels which are now building for the International Navigation Co.

Tubulous Boilers.

The discussion thus far of reduction of weight assumes that the boilers themselves are not changed materially otherwise than for the fitting of the forced draft appliances, but the question has been a very vital one for some time past, and is now of extreme importance whether we shall not entirely abandon the present types of boilers and adopt a very much lighter one by using what are called coil or tubulous boilers. This matter has been discussed so much by so many able minds that it is unnecessary for me to go into the matter at length here. We all know the great advantages of these boilers in the way of immense reduction of weight, safety against disastrous explosions, rapidity with which steam can be raised, absolute safety against injury from any amount of forcing, and the ease with which, if necessary, a boiler can be removed and replaced. Almost the only objection appears to be the fear that they will not be durable because of the fact that they are composed almost entirely of very thin tubes, and our experience with these tubes in ordinary boilers has not been such as to lead us to expect a very long life from the coil boilers. However, some coil boilers have been in use for five or six years without showing appreciable deterioration, and a few have been used with fresh water entirely for more than 10 years.

We are treating this matter on a large scale on the "Monterey," where we have four coil boilers of the Ward type, in connection with two cylindrical boilers. These boilers have given great satisfaction in their trials, and the cruise of the "Monterey" will demonstrate the matter of their durability. I may say that, in my opinion, if the experience with the coil boilers on the "Monterey" and on other sea-going vessels should prove to be entirely satisfactory, it will only be a short time until the cylindrical boilers will be almost entirely displaced.

Reducing Weights of Engines.

While on this question of weight, we must not forget the engines themselves, where the weights have also been very materially reduced. As we are all well aware, this has been due to three causes: an increase of steam pressure, an increase of piston speed, and the use of stronger materials. Piston speeds have more than doubled in the last 15 years, and our larger vessels are now running with piston speeds of about 950 ft. per minute, while some of the smaller ones, like the torpedo boats, are designed for a piston speed of over 1,000 ft. If materials should go on improving so that we can reduce the weight of our reciprocating parts, I see no reason why piston speeds should not be increased still more, which of course would result in still further reducing weights. If we adopt the coil boiler generally, we shall also carry very much higher steam pressures, because we already are carrying pressures of 250 lbs. in some of our torpedo boats with great success. We have greatly reduced the weight of most of the engines by the use of forged steel for piston and connecting rods, valve stems and shafting, and cast steel for pistons, valves, bedplates and frames, but there does not at present seem to be much prospect of displacing cast iron as the metal for cylinders. If this should come about, we could still further reduce our weights, and, if nickel-steel should within the next 10 years become as commonly used as mild steel is now, we would have a big reduction in weight all around. In fact, these questions of high piston speeds and better material hang together, for the reason that the limit to piston speeds is now placed by the weight of the reciprocating parts, whose inertia will be so great after passing a certain speed that for the early part of the stroke the piston would be giving out no work, but simply be dragged around. If the reciprocating parts can be reduced in weight, of course the speed can be increased until the limit is again reached.

Coal Consumption on Full Power Trials.

One matter which has been of great interest to all engineers has been the coal consumption on full power trials. We are all very familiar, doubtless, with the claim we constantly hear that a good triple expansion engine with high-pressure boilers gives a horse-power for $1\frac{1}{2}$ lbs. of coal. Our own results have never approached this, and estimates of the coal burned on trial trips also tend to disprove it. Finally, we are able on some of our trials to get thoroughly accurate results with the assistance of the contractors, by having the coal weighed in bags of 100 lbs. each, which could be counted as they were emptied and then again counted after the trial was over. In another case a supplementary coal consumption trial was made with half the boilers, and every effort was made to keep the conditions exactly the same as on the full power trials, in that the air pressure was the same and the engines were run so as to work off all the steam formed. As a result of these trials we found that the consumption for full power was more than 2 lbs., and in some cases as high as 2.6 lbs.

In one of my annual reports to the Secretary of the Navy, I called attention to the cause of this difference between the economy of war vessel machinery and that of merchant vessels, and we happened to have very reliable data which had been published of the performance of a particularly economical merchant vessel which was tested by a committee of the English Institution of Mechanical Engineers, under the superintendence of Prof. A. B. W. Kennedy, F. R. S. In this ship, the "Iona," the boiler has a ratio of heating to grate surface of 75 to 1, which, I think, tells the whole story. In our war vessels we can never exceed a ratio of about 35 to 1, and then at full power we burn a very much larger amount of coal per square foot of grate, thus making our up-take temperatures very much higher than they were on the "Iona," so that a large amount of heat must have gone up the chimney without doing any useful work. I may say that these coal consumption tests at full power were the first that had ever been made, and I have not learned of any others having been made since. It of course involves considerable trouble and some expense, and it is only right that the government should be the one to meet the expense, for the information was certainly of great value.

Standardizing Indicators.

The early vessels for our navy were contracted for with the understanding that they were to develop a certain horse power. The contractors felt that with an agreed steam pressure to start with and known sizes of cylinders they could confidently guarantee that they would develop a certain horse power, but we had up to that time no reliable data on which to base our speeds, all our information being of foreign ships, and, while I do not for a moment pretend to say that their trials are not conducted with every effort to secure fairness, we of course did not know all the circumstances, as we have since, about our own ships, and so might be pardoned for feeling a little uncertain. In connection with the contract, it was provided that for each horse power in excess of the guarantee there should be a certain premium, usually $100, and for every horse power below the contract requirement there should be a fine of the same amount. This made it very important that the horse power should be determined accurately.

Experiments which had been made to compare different indicators had shown that no indicator is absolutely accurate at any pressure, and, while those well made did not vary a great deal, there nevertheless is a difference which is worth considering, because, in the case of a large engine, it will make a very decided difference. In one of the earliest of our large ships the horse power, without correction, was over 10,000, while, when the corrections were applied, it was reduced to slightly less than 9,000. This naturally created a great deal of dissatisfaction on the part of the contractors, but it was due entirely to the defects of the indicators used, some of which were as much as 20 lbs. different from the assumed scale at the higher end of the range.

This case and one or two others called the attention of contractors to the matter, so that when purchasing indicators to be used they sent them to the New York Navy Yard, where we have the most elaborate and accurate testing apparatus in the world, and they declined to receive any indicators where the errors were more than a certain amount. The makers of indicators, stimulated by these requirements, have faced the problem manfully, and I am very glad to say that there has resulted a very decided improvement in the accuracy of the springs. In fact, not long since, 72 springs were purchased from one maker under a guarantee that the error should nowhere exceed 3%, and out of the 72 only 7 had to be rejected, and in these the error was really very small and at the lower end of the scale, where the value in percentage of a given error in pounds is of course greatest. For use on a trial trip these indicators would have been extremely satisfactory, and the error was remarkably uniform.

It has sometimes been sarcastically remarked by persons interested in this subject that the indicator corrections are always disadvantageous to the contractor. This is not strictly true, although it is almost always so; but the reason is perfectly simple, I think, and I think we can all understand just why it should be so. Let me say at once that I believe the indicator makers have always worked with an honest desire to have their instruments as reliable as they possibly could be. The errors which exist are not due to carelessness of manufacture, but simply to the conditions of the case, which preclude the possibility of absolute accuracy. Recognizing that this was the case, we can readily understand why the indicator makers should have made the instruments so that the error should be on the side of giving a larger horse power than the true one, because that is what everybody wants. These government tests are almost the only ones with which I am acquainted where there has been any effort made to apply the indicator corrections. In other cases the indicators have been standardized, and as long as the error did not exceed a certain amount they were taken as correct, and the horse power worked out accordingly. As both manufacturers and owners desire to have engines make as large a horse power as possible and show as low coal consumption per horse power as possible, it was only reasonable that, as a variation from strict accuracy was impossible to avoid, it should have been on the side of showing the larger horse power. At the risk of wandering a little from my subject, I may just say in this connection that we have been criticised for our method of testing indicators, on the ground that the conditions were not absolutely identical with those under which the indicator was used. This, of course, is true, as nobody has yet been able to suggest a method of testing the indicator which will enable any record to be made for comparison when it is working as rapidly as it is when attached to an engine making 300 or more revolutions per minute. But, on the other hand, the natural answer to this objection is that the modifications the old Richards indicator by the various modern types came about because, at high speeds, the indicator did not give reliable records, and the claim has always been, and still is, so far as I know, that while the modern indicators are thoroughly reliable at high speeds they are equally so at low ones. If our method of test is not thoroughly satisfactory, it is incumbent on the indicator makers to show at how low a speed their indicators cease to give accurate results.

I may say in this connection that one of the young officers of the Engineer Corps, who had a great deal of experience in this work of testing, began a series of crucial tests at the New York Navy Yard to determine whether there was any error in the methods we had been using, although neither he nor any of the rest of us who had studied the matter deeply believed that there was any error. Orders to other duties took him away before he was able to complete his experiments, but he had carried them far enough to satisfy him that the method employed is entirely correct.

Speed Trials with Standardized Screws.

It may possibly not seem strictly germane to the title of this article to bring in the matter of speed trials, but I do so merely to call attention to a method which I had the honor to bring to the attention of the Navy Department, and which was unanimously approved by the Board of Construction of that department, and was used with great success in the trial of the "Bancroft" early in this year. It consisted in a series of progressive trials for the purpose of standardizing the screw and determining accurately the number of revolutions corresponding to a particular speed. Then, having laid a curve to show the relation of speed to revolutions, the vessel could be taken to sea anywhere and the continuous endurance trial run off and the speed at once determined as soon as the average revolutions for the entire period were known. Doubtless many of you are aware that the fast Argentine cruiser, the "Ninth of July," was tested in this way; and, I believe, several other foreign vessels also have been. This method enabled the speed to be accurately determined with less difficulty than any other which had been suggested. Patent logs are out of the question, and the run over a long course, which the department is now using, involves the attendance of a very large staff of observers and several ships besides the ship which is making the trial. In the case of trials by the standardized screw method, no other observers are needed than those on the ship itself.

The objections to the trial over a long course occur at once to any one who gives much attention to the matter in the difficulty of laying out the course accurately in the first place, and then the fact that everything which may go at all amiss operates against the contractor. One of the great advantages of the standardized screw method is that in case the performance of the vessel improves from the very beginning, the trial may be prolonged an hour or two, and then any consecutive four hours taken as the one on which the record will be based. Of course, it goes without saying that, if the last four hours of the trial are better than the first four, the government is getting a ship whose excellence has been demonstrated more conclusively than by the performance of the first four hours. An additional advantage of this standardized screw method is that the progressive trials over the measured mile enable data of great value to the designers of both hull and machinery to be obtained in getting the relation of horse power to speed at the various speeds run.

Special Cruisers for Use in Time of Peace.

Again, at the risk of being considered somewhat away from my subject, I think it may not be amiss for me to say a word which is based on the matter of economy of machinery at low powers, of which I have already spoken. This is a design for an economical peace cruiser. I think all who have studied the matter carefully cannot fail to be struck with the idea that it was a mistake to build small vessels of very high speed for duty as cruisers. I mean vessels of, say, 1,500 to 1,800 tons displacement, designed to make 17 or 18 knots. The machinery necessary to produce this power occupies so much available weight that the amount left for coal is relatively small and the radius of action is very limited. These vessels very rarely in peace time are called on to run at a speed anywhere near their maximum, so that, as a matter of fact, during their entire lives, barring a war, they are simply carrying around a large weight of engines and boilers which would be useful in an emergency, but which, as things actually go, are entirely useless.

In case of war these vessels are not sufficiently powerful to fight any real war vessel, and they are not fast enough to capture any very valuable merchantman, even leaving out of consideration the fact that no vessel would remain under the flag of one of the belligerents in time of war.

It would seem, therefore, that it would be an economical thing for the government to build a number of vessels which should be intended entirely as peace cruisers, and which, in time of war, would be laid up. The office of these cruisers would be to go around and show the flag, to look after the interests of American citizens abroad, and, in case of necessity, as happened recently at Honolulu and elsewhere, to land troops. Consequently, they should be able to carry a relatively large crew, and should have as large coal capacity as possible.

It seems to me that a vessel of about 2,500 tons displacement, with engines of, say, about 1,500 HP. for full power under forced draft, would fulfill these conditions admirably. This would give us a speed of about 12 or 13 knots at full power under forced draft, so that with natural draft at full power she could steam with great economy at 8 or 9 knots. The coal capacity would be about 675 tons; and, as the arrangement of auxiliaries could be designed with special reference to economy, she could be safely put down for a radius of action of about 13,000 knots at a speed of 9 knots. I would by all means have such a vessel sheathed, echoing most heartily the efforts which my good friend, Chief Constructor Hichborn, of the Navy, has been making for so many years. The boilers and engines of this vessel would be specially designed with regard to the maximum economy at cruising speed, and I believe that a dozen such vessels would save enough during their career to more than pay for themselves.

FORESTRY AND TIMBER EXHIBITS AT THE COLUMBIAN EXPOSITION.

It is to be hoped that the exhibits in the Forestry Building (and the kindred exhibits of the Forestry Division of the U. S. Department of Agriculture, in the Government Building) were carefully studied by every engineer and architect who could possibly find time and opportunity to do so. The growth, development and properties of timbers are too little understood by the men who employ timber so extensively for structural purposes, and in these exhibits were presented not only specimens of timber in the log, plank and finished work, but also test specimens contributed by the Forestry Division (showing the work of the government timber investigations), by McGill College, Montreal, and also shown in the Michigan state exhibit, in the Forestry Building. Apart from its scientific interest, the timber exhibit was of artistic interest, since there were many beautifully grained and colored woods which were far more pleasing to the eye than a great number of the mediocre and wearisome pictures in the Art Building. It is impossible to describe the beauty of some of these specimens, ranging from the somber walnut and mahogany to the rich English oak and Indian vermilion wood, and the light birds-eye and curly maple. They were shown in small panels and in huge planks, and even logs sawed in half and highly polished and varnished, while leaves, nuts and buds, photographs of trees and forests were also displayed. Numerous foreign countries were represented, with Russia, Germany and New South Wales at the head, and a large number of the states had individual collections of their timbers and wood products. In regard to the artistic appearance of the exhibit it may be noted that one exhibitor grumbled at the bad light in the way that we are accustomed to hear exhibiting painters grumble at the light on their pictures. The Forestry Building was entirely of wood, and the roof over the piazza which surrounded it was supported by columns of natural wood, unbarked, all clearly and distinctly labeled. The "big trees" were, of course, represented, and there was the largest plank in the world, 16 ft. 5 ins. wide, 12 ft. 9 ins. long and 5 ins. thick, cut from a redwood tree in Humboldt Co., Cal., 300 ft. high and 35 ft. diameter, estimated to be 1,500 years old. Manufactures of wood made an extensive exhibit, including tanks, barrels, domestic and culinary articles, tables, doors, decorative work, etc. Kilns for drying lumber and H. M. Crittenton's patent log thawing apparatus, using exhaust steam, were shown by models. In wood products there were resin, tar and gum; paper pulp; wood fiber mats, baskets, hammocks, etc., medicinal articles, and innumerable articles of indurated fiber by the Indurated Fiber Ware Co., of Chicago. An exhibit of wood products by J. Mathieu, of Chicago, included the utilization and treatment of fallen trees and refuse from lumbermen, sawmills, etc., for the production of wood alcohol, charcoal, tar, turpentine, acetate of lime, etc. Mr. Mathieu owns the patents on kilns and apparatus for this treatment. In the New South Wales exhibit were a section of wood block pavement, photographs of streets and specimens of blocks of different woods. These blocks are 6 × 2¾ × 8½ ins. in size. In timber preservation there were the zinc chloride process, by F. Goldschmidt, of Germany, and the Finch process (particulars not given), which has shown excellent results in sidewalk planks and street paving blocks at Toronto, Can. Some of the planks and scantling have been laid for seven years, and in May last were turned over and are still in use. The material is furnished by the Finch Wood Preservative Co., of Toronto. Other preservative processes exhibited have been referred to in our article on the track exhibits. In addition to the timbers and wood products the exhibits relating to forest botany, timber culture, forest management, lumbering, etc., were of great importance and interest at this time, when the United States is beginning to take steps for the preservation of its timber resources.

RECENT DEVICES FOR DETECTING FIREDAMP IN COAL MINES.

The need of some simple apparatus for determining the presence of firedamp in dangerous proportions in the atmosphere of coal mines has led to the invention of several ingenious devices of more or less practical utility for this purpose. Two of these, a laboratory instrument invented by Mr. Thomas Shaw, of Philadelphia, Pa., and a portable underground instrument invented by Mr. G. Chesneau, Professor at the National School of Mines, Paris, are illustrated in the accompanying cuts.

The apparatus invented by Mr. Shaw is designed to indicate automatically the presence of an explosive gas in any atmosphere, and also, by a simple calculation, the exact proportion of the gas. Its operation is based upon the principle that the limit of inflammability of a gas is a definite quantity, capable of being determined with great exactness. A perspective view of the instrument ready for use is shown in Fig. 1.

The apparatus consists of a pair of pumps, one A for air and the other B for the pure gas used as the base. These pumps are operated by the crank N in a manner readily understood from the illustration. The air cylinder A is stationary and its stroke is always constant; but the gas cylinder B is movable and can be set at any point on the graduated bars S, so that it will make a stroke of any length and pump any desired percentage of the volume pumped by the air cylinder.

The flow from the two pumps passes into an igniting chamber Z, which has an aperture on one side in front of a gas jet. Should the mixture pumped into this chamber be ignitable, combustion will take place and the expansion caused by the heat will force a loose piston head at the end of the chamber against a gong J, producing an audible sound.

To determine the presence of a combustible gas in an atmosphere by this instrument, the process is as follows: Supposing it is wished to test for the presence of illuminating gas. The limit of combustibility of illuminating gas is 8.1%. The gas cylinder is attached to a reservoir of pure illuminating gas and adjusted to pump 8.1% of gas, while the air cylinder is connected with a bag of the atmosphere to be tested. The air cylinder, of course, pumps 91.9% of the combined product of the two cylinders. Now, if the atmosphere being tested contains any illuminating gas, it is evident that this added to the 8.1% of pure gas pumped by the small cylinder will raise the proportion of the gas in the combined product of the two cylinders, which is stored in the igniting chamber, above the ignition point and that there will be an explosion and the gong will ring. This will then prove that illuminating gas is contained in the atmospheré tested.

To determine just how much gas the air contains the percentage of pure gas pumped is gradually reduced until the gong ceases to ring. Suppose it ceases to ring when 7.6% of pure gas is pumped. Then 8.1 — 7.6 = 0.5% = the proportion of gas contained in the atmosphere tested.

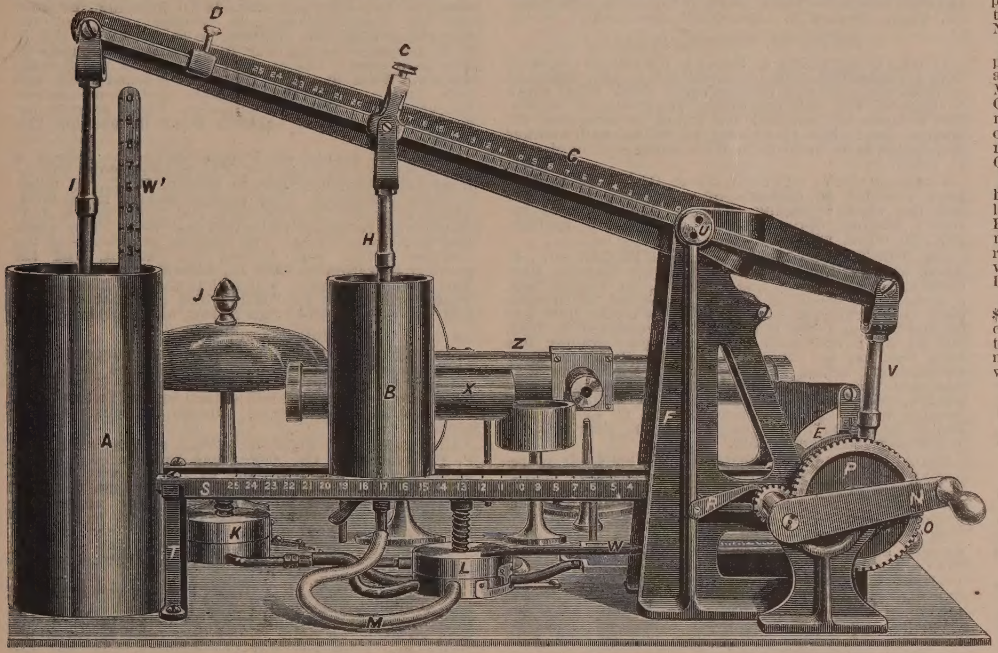

FIG. 1. THE SHAW FIRE DAMP INDICATOR.

In testing for firedamp the process is not quite so simple as that described above, owing to the fact that some other gas, as illuminating gas or methane, is used as a base. It is observed that a mixture of air with two inflammable combustible gases becomes inflammable when

$$\frac{n}{N} + \frac{n^1}{N^1} = 1,$$

n and n^1 being the volumes of the respeotive gases mixed with sufficient air to make 100 volumns of the mixture, and N and N^1 being the respective limits of inflammability of the two gases tested separately.

To determine the proportion of firedamp contained in a given sample of air it is therefore sufficient to add either illuminating gas or methane until the mixture becomes inflammable. The volume of x of firedamp contained in 100 volumes of the sample from the mine is then given by the following formula, which is easily deduced from the preceding one:

$$x = \left(1 - \frac{x}{N}\right)\frac{600}{100 - n},$$

in which n is the volume of combustible gas added to the mine sample in order to make 100 volumes of a mixture at the limit of inflammability; and N is the volume of the same gas which must be added to pure air to secure the same result.

The general principle and method of operating the Shaw apparatus will be readily understood from the foregoing. It is primarily a laboratory instrument, and owing to its size and the delicacy of its construction not easily adapted to use underground. The instrument was on exhibition at the Columbian Exposition, in the east gallery of the Mining Building.

The instrument invented by Mr. Chesneau is shown in Fig. 2. Its operation is based upon the fact that a flame, or sufficiently hot body, introduced into an atmosphere containing firedamp in a proportion below the explosive point, 6%, causes combustion only in a larger or smaller zone surrounding the hot body, the size of the zone depending upon the proportion of the gas. This zone of burning gas is easily distinguished by the color of the flame and is called an aureole. The instrument is thus designed to indicate the proportion of combustible gas by the height of the flame aureole.

The instrument consists essentially of a brass reservoir A for the alcohol to which a small amount of cupric chloride has been added for the purpose of coloring the flame and thus increasing its contrast with the flame aureole; a circular crown made of double wire gauze B, serving for the admission of air; a hollow cylinder C made of sheet metal, surrounding the wick holder and serving as a shade; an iron wire gauze D, the collar of which, resting on the hollow sheet metal cylinder, completes the shade; and of a sheet iron shield E provided with a window for observation closed by a sheet of mica as thin as possible to permit accurate observation. A scale is painted on each side of the window by which the height of the flame aureole is measured. This scale gives tenths of 1% of firedamp.

The operation of the lamp is, briefly stated, to turn down the alcohol flame until its top is just level with the top of the shade, z z, and then gage the height of the aureole by the scale on the side of the window. Up to 0.5% of gas there is difficulty in distinguishing the aureole, but beyond this percentage the observation can be easily made.

In regard to the precision of the instrument Mr. Chesneau states that the average error in a series of over 200 tests was 1%, which is much less than actual practice calls for. The instrument is, of course, designed as an indicator for underground work only and should be used in connection with a laboratory instrument for checking readings.

In connection with the Chesneau lamp it may be stated that a somewhat similar lamp invented by Prof. Frank Clowes, University College, Nottingham, England, has been very successfully used in that country. This lamp consists merely in fitting a hydrogen gas burner to the ordinary Davy lamp and measuring the flame aureole by it. The hydrogen gas is carried in a small reservoir of pocket size, which can be attached to the lamp when a test is to be made. At other times the lamp is used as an ordinary mine lamp. It is stated that this lamp will detect as low as 0.2% of firedamp.

All of these devices are, however, merely cautionary in character and should be supplemented by every precaution in operating fiery mines. Good ventilation is the best preventive against explosions from firedamp and the various indicators are of value largely because they enable the inspector to follow the variations in the percentage of firedamp at different points in the mine and to regulate the ventilation accordingly.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BANGOR & AROOSTOOK.—We are informed that tracklaying is expected to reach Houlton, Me., by the middle of December or before that time. Houlton is 93 miles from Brownville, the southern terminus of the line.

DUNKIRK, ALLEGHENY VALLEY & PITTSBURG.—It is reported that the project of extending a branch of this road through to Glade has been revived. New York Central surveyors were at Warren, Pa., last week looking over the proposed route. It is probable that the proposed extension will go through to Sugar Grove, Pa., and connect with Jamestown, N. Y., by way of that place.

GEORGES VALLEY.—This railway has been completed and was inspected last week. It extends from a junction with the Knox & Lincoln division of the Main Central in the town of Warren, Me., to Union Common in the town of Union, a distance of eight miles. Efforts are being made to secure an extension of the road from Union to Appleton, a distance of five miles. Pres. and Treas., W. W. Case, Rockland, Me.; Gen. Man., Fred A Allen, Union, Me.

KINGFIELD & DEAD RIVER.—McGregor Bros. have completed the grading of this road and tracklaying is now in progress. The line extends from Kingfield, Me., on the Franklin & Megantic road, north about 10 miles through the Dead River region, and is intended to open up a large tract of white birch timber. Pres., V. B. Mead, Boston, Pres. Franklin & Megantic R. R.

PENNSYLVANIA CO.—This company has sold $4,000,000 of gold 4½% bonds of the Pittsburg, Cincinnati, Chicago & St. Louis Ry. and the proceeds of the sale will be used to defray the cost of improvements and new construction on the company's Southwestern line, according to reports.——It is stated that an extension will soon be built from some point on the Logansport division to Indianapolis. It now uses the tracks of the Lake Erie & Western into Indianapolis. This item probably refers to the proposed Indianopolis, Logansport & Chicago road which is said to be projected in the interest of the Pennsylvania Co., and for which the right of way has nearly all been secured, as stated last week.

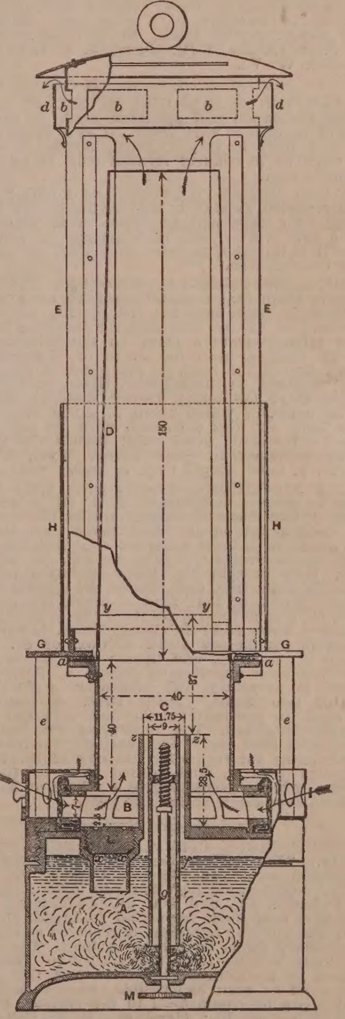

Fig. 2. The Chesnau Fire Damp Indicator.

SOUTH JERSEY.—Arrangements for the construction of the Cape May branch of this railway from Tuckahoe, N. J., to Cape May have been completed, according to reports, and work is to be commenced by the Tennis Construction Co., Dec. 1, with 100 men.

Projects and Surveys.

PROVIDENCE, PONEGANSETT & SPRINGFIELD.—The towns of Foster and Scituate, R. I., have taken action with a view to aiding this proposed road. Col. E. C. Green, Engr, in charge of the surveys, is reported to have stated that the preliminary work has been completed and fully one-half the bonds of the company floated. It is intended to commence the construction at an early date.

Southern—Existing Roads.

VALDOSTA SOUTHERN.—It is stated that the old Florida Midland & Georgia has been reorganized under the above name, and that the road will be built from Valdosta, Ga., on the Savannah, Florida & Western, south to Madison, Fla., on the Florida Central & Peninsular, 25 miles. Part of the grading has been completed.

WELSH COLONY.—D. S. Thomas, Pres., Penbro, W. Va., sends us the following letter: The Welsh Colony R. R. of W. Va. was incorporated under the laws of this state, the shareholders being mostly Welsh colonists from Pennsylvania who have bought lands in Webster and Randolph counties, W. Va., for a new settlement. This new town site is located on high table land and near the headwaters of Devil's Fork of Buckhannan River, the Fall Run and Laurel Fork of Holly River and about three miles from the headwaters of Little Kanawha River, a very strategic location from a railway standpoint. Penbro is the name of the town and post-office and is situated in the northern part of Webster county. The railway has been graded from Avondale Junction, on the Buckhannon branch of the W. Va. & P. R. R., up Devil's Fork to Penbro, and wood rails are being laid to accommodate lumbermen who are anxious to ship lumber to market at once. The grade is 2 to 4° for the first half mile and 1½ to 2° for the other 2½ miles to head of grade at Penbro. From this place branches can be run at a very good grade to Little Kanawha River, Holly River or Sugar Creek. The company expects to change the wood rails for steel and to have a standard gage railway in operation in the future. The country is rich in lumber, coal, fire clay of high grade and other minerals. The headquarters of the company are at Penbro, Webster Co., W. Va.

Projects and Surveys.

BROWNSTOWN & COAL RIVER.—This company has been incorporated in West Virginia to build a railway from Brownstown to a point near Madison, in Boone county; capital stock, $50,600; Geo. Davis, R. Ewer, J. N. Carnes, J. R. Guard, J. J. Lovell, all of Charleston, W. Va.

Northwest—Existing Roads.

BURLINGTON & MISSOURI RIVER.—It is stated that the Deadwood and Spearfish road, in South Dakota, will be opened this week. It is a standard gage road. The road is very crooked, 30 miles of track being required to connect termini only 18 miles apart in a direct line.

CHICAGO GREAT WESTERN.—An officer of this road is reported as stating that owing to the business depression no steps will be taken to an extension of the line this winter, but that during the latter part of 1894 it is intended to commence work on an extension to Omaha, Neb.

DAKOTA, WYOMING & MISSOURI RIVER.—Local papers state that negotiations have been completed with English capitalists for the placing of bonds to the amount of $20,000 per mile for building 320 miles of this railway from a point on the Missouri River in South Dakota, into the state of Wyoming. The proposed line of the road, as projected, is from Chamberlain, S. Dak., on the Missouri River, surveyed west to Rapid City, 188 miles; thence west to Mystic, S. Dak., 33 miles, of which about 27 miles were graded, bridges built and ties delivered, with 5½ miles of the line laid with 65-lb. steel rails; thence the line was partially surveyed to Skull Creek, Wyo., 55 miles. Pres., W. T. Cood, Rapid City, S. Dak.

GREAT NORTHERN.—Press reports state that according to present indications, J. J. Hill's scheme of running a line from Holyoke, on the Eastern Minnesota, to a point on the Red River line, thence to Cloquet, and from there extend a spur into the Mesaba Range, is, according to late reports, to become a reality. It is thought Mr. Hill's intention is to parallel the Mesaba line, and this is the opinion of Chief Engineer Martz, of that road.——Work has been commenced on a spur from a point on the Willmar branch about three miles from St. Cloud, Minn., to the granite quarries of Hennessey Bros. & Cox, of St. Paul, a distance of one mile, and thence to what are known as the Robinson quarries, of which R. Fothergill, of Chicago, is secretary and treasurer, a further distance of two miles. Foley Bros. & Guthrie, St. Paul, have the contract for the first mile and will lay the track this fall. The remaining two miles will not be completed until next spring. The road is to be built ready for trains by the city of St. Paul and the quarry owners, and turned over to the Great Northern, which agrees to give a rebate of 25% on all shipments over the spur for two years.

Projects and Surveys.

CHICAGO, SIOUX CITY & BISMARCK.—The Sioux City, Ia., "Journal" states that this company has consolidated with the Chicago, Cascade & Western Ry. Co., incorporated last April to build a road west from Dubuque, Ia., and that all preliminary arrangements have been made for actual fieldwork. C. J. Beattie, an officer of the company, is reported as saying that the necessary funds have been secured. The first line to be built will be from Sioux City to Pierre, with Bismarck as its ultimate terminus, and this line will be surveyed as soon as possible, so that actual construction can be commenced in the spring. Pres., Ira Brown, Wheaton, Ill.; Vice-Pres., B. F. Bell; Treas., D. H. Lee; Secy., S. C. Rollins, Chicago.

DULUTH, RED WING & OMAHA.—A dispatch from Omaha, Neb., to the Sioux City, Ia., "Journal" states as follows: Interest has again been aroused in railway circles by the news of activity in regard to the proposed Duluth, Red Wing & Omaha R R. The business men of Omaha have long looked forward to the time when the city would have better facilities for reaching the northwest than it has now. It is claimed that five railway systems are ready to enter Omaha whenever a connection is made with the city at Fort Dodge or some other point equaly favored These roads are the Mason City & Fort Dodge, the Chicago Great Western from Chicago and Minneapolis, the Winona & Southwestern to Osage, Ia., the Illinois Central and the Duluth, Red Wing & Omaha. It is also pointed out that could a traffic arrangement be made with the Milwaukee from Council Bluffs to Manning, and from Manning to Carroll by way of the Chicago & Northwestern, then only 40 miles of road would have to be built from Carroll to Fort Dodge to open the gateway for five new systems. The chief interest Omaha has in the matter is to enable the city to reach the lake without paying tribute to Chicago.

MINNEAPOLIS, ST. PAUL & LAKE SUPERIOR.—The intention of beginning work this winter on this proposed railway between Minneapolis and West Superior, Wis., 135.8 miles, has been abandoned, according to reports. The construction will probably be commenced in the spring. Pres., Donald Grant, Faribault, Minn.

ST. LOUIS, COLLINSVILLE & EASTERN.—This company has given a chattel mortgage and deed of trust to the St. Louis Trust Co. for $250,000, which covers the company's right of way from East St. Louis, Ill., to Collinsville and all the appurtenances to the road. This is to enable the company to build and complete the road. It was reported some time ago that bids were being received for the construction. Ch. Engr., Edward T. Lurton, Collinsville, Ill.

Southwest—Existing Roads.

GULF, COLORADO & SANTA FE.—It is reported that a proposition will be submitted to this company to build the proposed line surveyed from Waco south to Rogers, Tex., by the Waco, Mooreville & Austin. The citizens of Crawford are trying to secure an extension from that place east to Waco, and another proposition is to build from Waco southwest to Moody, 21 miles.

KANSAS CITY, PITTSBURG & GULF.—This company received 55 carloads of steel rails last week and the work of laying them on the new line between Sulphur Springs, Ark., and Siloam Springs, Ark., 25 miles, will be commenced at once.

LA PORTE, HOUSTON & NORTHERN.—J. F. Allen, who has the contract for the road between Harrisburg, near Houston, and La Porte, on Trinity Bay, a distance of about 16 miles, is reported as to complete the tracklaying next week. This is the main line of the road and the grading was completed in 1892, but no track laid until this fall. Some grading has been done on an extension from La Porte to Clear Creek, eight miles, and it is thought probable that this line will also be completed before work is suspended. The road is built through a rolling prairie country with a grade of less than 20 ft. to the mile and a maximum curvature of 1°. Ch. Engr., C. G. Woodbridge, La Porte, Tex.

SEDALIA, WARSAW SOUTHWESTERN.—It is reported that work will soon be commenced on changing this railway to standard gage. The line extends from Sedalia, Mo., to Warsaw, 43 miles, and it is proposed to extend it south to Springfield.

STATE PENITENTIARY.—Work has been commenced at Rusk, Tex., on a railway to state lands four miles distant in the direction of Palestine, where coal camps are to be established. The road is being built by the state penitentiary and will probably be extended to a connection with the International & Great Northern as soon as practicable. The road is narrow gage, but the grading and bridges will be built with a view to widening the gage at some future time.

TEXAS CENTRAL.—It is reported probable that work will soon be commenced on the proposed extension from Ross to Waco, a distance of 10 miles, and on the depots and shops to be built at the latter city. Gen. Man., Chas. Hamilton, Waco, Tex.

TEXAS MIDLAND.—Bids have been received by E. H. R. Green, Pres., Terrell, Tex., according to reports, for the construction of the proposed southern extension of this railway.

Projects and Surveys.

DAKOTA, WICHITA & GULF.—Preparations are being made for an interstate convention to be held at Topeka, Kans., Dec. 5 to advance the interests of Gov. Lewelling's projected railway from North Dakota to the Gulf of Mexico. It is stated that Senator Allen, of Nebraska; ex-governors Ireland and Hubbard, of Texas; W. E. Hutchinson, of Kansas, and other prominent men are interested in the scheme.

KINGS RIVER.—Incorporated at Little Rock, Ark., to build a railway from near Baldwin, on the St. Louis & San Francisco, eastwardly through the counties of Washington and Madison to Kingston, a distance of about 38 miles; capital stock, $600,000; H. M. Coulter and A. P. Moore, St Louis; R. J, Wilson, T. M. Gunter and B. R. Davidson.

Rocky Mt. and Pacific—Existing Roads.

BURLINGTON & MISSOURI RIVER.—A press report states that this company has engineers in the Rocky and Bitter Root mountains seeking favorable passes to the west and that the road will be extended to the Pacific coast as soon as the financial outlook is brighter, the line passing through Spokane, Wash.

COLORADO MIDLAND.—A report from Colorado Springs, Colo., stated that the rails for the Midland Terminal line to Cripple Creek were in transit last week, and that they would be laid as soon as possible; also that the line would be extended from Cripple Creek to Florence, thus becoming a competing line with the Florence & Cripple Creek road now under construction. The road is expected to be completed to Midland, nine miles from Cripple Creek, by Dec. 5 and to Cripple Creek by early spring. Pres., H. Collbran Denver.——The first passenger train will run through the Busk-Ivanhoe tunnel on Dec. 5, according to reports.

FLORENCE & CRIPPLE CREEK.—It is reported that actual construction has been commenced on this road, and that a larger force will be put at work as soon as D. H. Moffat, Denver, and Wm. A. Johnson, Pres., have returned from the East. The line will be about 48 miles long and will probably become a part of the Denver & Rio Grande system.

GREAT NORTHERN.—A press dispatch from Tacoma, Wash., states that this company is supposed to have secured an option on land at Commencement Bay, a suburb of that city, for terminals, the proposition being that work must be commenced by February next and the railway completed by July.

HELENA & SOUTH MOUNTAIN.—The grading on the first 25 miles of this railway is reported as under way. The contract was awarded to James Brown, Butte, Mont., as stated in our issue of Oct. 12. The road is projected from Helena to Dillon, 150 miles, and will touch near Virginia City, Bannock and Sheridan. Samuel Wood, Helena, Mont., is the chief projector.

OREGON PACIFIC.—It is reported that this road will be extended eastward to Boise City next year. The line was projected from Yaquina, Ore., to Boise City, Idaho, a distance of about 600 miles, and 142 miles, from Yaquina to Boulder Creek, Ore., were completed in 1890. Receiver, E. W. Hadley, Corvallis, Ore.

PORT TOWNSEND SOUTHERN.—The company has filed a mortgage at Olympia, Wash., for a railway through the counties of Jefferson, Mason, Chehalis, Thurston, Coroletz and Clarke to the Columbia River. Bonds on the line are not to exceed $20,000 per mile. Gen. Man., C. J. Smith, Seattle, Wash.

SAN PETE VALLEY.—This line was completed from Nephi to Ephraim, in Utah, some time ago and 18 carloads of steel rails were received at Ephraim last week to complete the line to Manti, eight miles, which has already been graded.

SOUTHERN PACIFIC.—The San Francisco "Chronicle" states that all the force that can be worked to advantage is employed on the Santa Margarita tunnel, which is the principal obstacle to finishing the road to San Luis Obispo. It is expected that the connection with that city will be completed by May 1. It is proposed to lay out new terminal grounds at San Luis Obispo, the present grounds not being satisfactory. When San Luis Obispo is reached there will still remain a gap of 110 miles to be built before the coast line will be completed. From present appearances there will be little delay in building this section.

SPOKANE FALLS & NORTHERN.—The Nelson & Fort Sheppard extension of this railway, from the international boundary line to Nelson, B. C., 60 miles, is about completed. Four bridges remain to be built, which will take 12 or 14 days, and there was a short distance of track yet to be laid last week. The whole road is 200 miles long. The heaviest grades are at the extreme Nelson end, beyond the summit, and the greatest elevation is 3,600 ft., according to reports.——The Nelson "Tribune" states that the terminus for the winter will be at Five Mile Point and that the road will not be completed into Nelson until spring.

Projects and Surveys.

BRITISH COLUMBIA PACIFIC.—A cablegram from London states that 130 tons of steel rails have been shipped to British Columbia, by way of Cape Horn, for this railway, which will extend by the Yellow Head Pass and in which several Chicago capitalists are interested.

MONTEREY & FRESNO.—Press reports state that P. P. Dandridge, Ch. Engr., has commenced the permanent survey for the route of this railway through the Coast Range and across the San Joaquin plains to Fresno. This work is expected to take about four weeks and will complete the permanent location of the line. The road will be 163 miles long and the contract for its entire construction was awarded several months ago to the California Construction Co., San Francisco.

SAN FRANCISCO & ATLANTIC.—Frederick Homer. San Francisco, the projector of this road, is reported to have stated that a corps of English engineers will soon go over the route, which has been surveyed between San Francisco and Los Angeles, and that the actual construction will be commenced at an early date.

UTAH & WYOMING.—Engineers at work on the survey for this projected railway are reported as stating that the construction of the road will be commenced in the spring and the road completed within two years. A corps of 15 surveyors is at work near Logan, Utah, and another party at Beaver Dam, locating the route to Ogden, Utah. Ch. Engr., John B. Taylor, Salt Lake City, Utah.

Foreign.

PANAMA, COLOMBIA.—A press report from this place states that the last rail was laid Nov. 11 on that part of the Cartagua & Cagsalena R. R., which connects Cartagena with Arjena, a prosperous and important town. Work on the road is being pushed rapidly toward completion and much enthusiasm is manifested over it by the natives and foreign residents. Great credit is due the officers in charge for their energy and perseverence in surmounting the many difficulties of construction met with.

STREET RAILWAYS.

BURLINGTON, VT.—The Military Post St. Ry. Co. is reported as planning to build the proposed electric railway from Winooski to Fort Ethan Allen in the near future.

FLORENCE, MASS.—Surveys are being made for the projected electric railway to Williamsburg.

MALDEN, MASS.—The West End St. Ry. Co. has been granted permission to use electricity as a motive power for its cars in this city. The order has been pending for several months. It provides for a 5-ct. fare between ay point in Malden and Scollay square, Boston, and that the electric cars shall be put in operation by Jan. 1, 1894.

ROCKLAND, MASS.—Efforts are being made to secure an electric railway to Hanover, a distance of five miles. The Rockland & Abington Ry. Co. offers to operate the line, but is not yet ready to build it.

NEWTOWN, N. Y.—The Brooklyn, Queens County & Suburban R. R. Co. was incorporated Nov. 24 to build a street railway 5¼ miles in length in Queens county. Its termini will be as follows: Route No. 1, Middle Village and Corona Park, in the town of Newtown; route No. 2, Middle Village and the town line of the towns of Newtown and Jamaica, where the town line is intersected by Metropolitan Ave. The directors include Frank Bailey, Edward Johnson, G. H. Southard, H. E. Hutchinson, Frederick T. Aldridge and Julian Fairchild, of Brooklyn.

PHILADELPHIA, PA.—Wm. A. Heulings, Jr., is president of the Manayunk Passenger Ry. Co., and A. A. Sterling, Wilkes Barre, of the Penn Traction Co., noted in our issue of Nov. 16 as incorporated.

PHOENIXVILLE, PA.—J. K. Perot is devising a plan to construct an electric railway to Spring City and Royersford, according to reports.

PITTSBURG, PA.—The Pittsburg & Homestead Electric St. Ry. Co. has been incorporated to build an electric railway about two miles long; capital stock, $12,000; Pres., Herman Lamb; E. G. Weinschenck, J. P. Wilson, Pittsburg, and H. H. Swaney, McKeesport, are directors.

POTTSVILLE, PA.—The Anthracite Electric Ry. Co. has been incorporated to operate an electric railway from New Philadelphia to Port Carbon and Mahanoy City; capital stock, $500,000; Pres., Thos. H. Walker.

MOUNT VERNON, O.—A franchise has been granted by the commissioners for an electric railway to be built between this city and Gambier and to the fair grounds.

TIFFIN, O.—The Tiffin Electric St. Ry. Co. has increased its capital stock from $50,000 to $60,000.

ELWOOD, IND.—The Indianapolis "News" states that a company of Logansport, Elwood and Franklin capitalists is being formed for the purpose of building an electric street railway from this city to Franklin. The movement is well on foot, and the cities will probably be connected by street railway within another year.

GOSHEN, IND.—The incompleted electric street railway, with all of its franchises, has been sold to W. W. Hatch and C. N. Chadwick, the contractors for constructing the line, for $20,064. This is believed to insure the completion of the line to Goshen and also to Elkhart.

CHICAGO, ILL.—The Grand Crossing & Windsor Park Ry. Co. has been granted a permit to construct a double track electric railway on 75th St. from the Illinois Central station in Windsor Park to Stony Island Ave. Traffic arrangements have been made with the Calumet Electric St. Ry. Co. whereby cars may be run to Grand Crossing.

HARDIN, ILL.—The business men of this place are reported as trying to secure an electric railway to Grafton or to Pearl.

SAN FRANCISCO, CAL.—The Sacramento St. cable road is to be extended to D St. and the Midwinter Fair Grounds, a distance of over a mile, the work to be commenced at once.——The officials of the new Mission St. electric railway have been experimenting with a storage battery system which it is proposed to adopt.

BRIDGES AND TUNNELS.

GREENE, ME.—The contract for a bridge across the Androscoggin River has been awarded by this town and the town of Turner to the Berlin Iron Bridge Co., at $7,050. The bridge will be 340 ft. long and have a 16-ft. roadway.

JERSEY CITY, N. J.—Bids are asked until Dec. 7 for the construction of two bridges. John Boyd, Clk. Bd. Freeholders.

VICKSBURG, MISS.—Bids are asked until Dec. 4 for building an iron bridge over Sharkey Bayou, on road No. 19, near Yokena. J. D. Laughlin, Clk. Bd. Supervisors.

ST. LOUIS, MO.—Soundings are being made in the Mississippi River, at Carondelet, seven miles south of that city, and it is thought that a bridge is proposed across the river at that place. The projectors of the scheme are unknown, but believed to be the Mississippi River & Bonne Terre R. R., recently changed to standard gage, and its allied corporations. A charter for such a bridge was granted to Thos. Allen, builder of the Iron Mountain Ry., but was afterward sold to Jos. Campbell and J. B. Clemens, of this city. Rumor states that the Carondelet & East Carondelet Bridge Co. will be formed to construct the bridge.

BROWNWOOD, TEX.—Bids are asked until Dec. 7 for the construction of a bridge across the Colorado River at Milburn Crossing; also for one across Pecan Bayou, at the Anderson Crossing, and for one across the Jim Ned, two miles north of Trinity. Chas. Rogan, Co. Judge.

WHARTON, TEX.—The following bids were received by R. F. Bentley, Co. Judge, for a steel bridge across the Colorado River: Youngstown Bridge Co., Youngstown, O., $19,868; Milwaukee Bridge Co., Milwaukee, Wis., $17,835; Penn Bridge Co., Beaver Falls, Pa., $18,891; Columbus Bridge Co., Columbus, O., $19,367; Geo. E. King Bridge Co., Des Moines, Ia., $21,350; King Bridge Co., Cleveland, O., $21,900.

WATER-WORKS.

BAR HARBOR, ME.—The sale of the works was completed last week. It is reported that many improvements will be made in the spring. The directors are J. S. Kennedy, D. B. Ogden, W. H. L. Lee, New York; C. J. Morrill, Boston; F. C. Lyman, Bar Harbor.

BATH, ME.—A town meeting will be held Dec. 2 to discuss the question of a supply.

SORRENTO, ME.—It is reported that the company is considering the securing of an artesian supply.

BELCHERTON, MASS.—The committee is getting plans preparatory to presenting them to the voters of the town, according to reports.

BOSTON, MASS.—The water board will receive bids until Dec. 23 for Mystic Station pumping engine No. 4.

CAMBRIDGE, MASS.—The board has reported the need of a high-service reservoir in Payson Park and of a high-service 20,000,000-gallon pumping engine.

MELROSE, MASS.—The town has voted to contract with A. C. Sibley for 360,000 gallons per day from Whittier Springs, at 7½ cts. per 1,000 gallons, Mr. Sibley to pump the supply; also to appropriate $2,000 for further investigation, and to issue water bonds for $20,000 on the Spot Pond improvement account.

NEW BEDFORD, MASS.—Geo. E. Evans and Geo. S. Rice, Boston, have reported plans for an additional supply. The work would include 40,000 lin. ft. 48-in. steel force main and a 48,400,000-gallon reservoir; estimated cost, $1,125,300.

SOUTH DEERFIELD, MASS.—C. L. Hayden, E. M. Roche and A. A. Jewett have organized the South Deerfield Water Co. with a capital stock of $50,000. The proposed supply is from Clapp's Brook.

WOBURN, MASS.—Engineers have reported plans for securing an increased supply from Horn Pond.

NORFOLK, CONN.—The Norfolk Water Co. will be organized next week, according to reports, the $6,000 required having been subscribed.

COXSACKIE, N. Y.—The board of trade is reported to have had parties looking over the water-works site.

NEWTOWN, N. Y.—The Citizens' Water Supply Co. has awarded contracts for wells and a pumping station.

ROCHESTER, N. Y.—The city treasurer has sold $300,000 of 4% water bonds at from 2⅜ to 2½% premium.

SCARSDALE, N. Y.—The Scarsdale Water Co. has been incorporated by C. W. Gaylor, F. G. Swartwout and others; capital stock, $15,000.

DECKERTOWN, N. J.—The question of works is again being agitated.

ELIZABETH, N. J.—The Lorraine Water Co. has been incorporated by W. A. Topping, H. S. Topping, New York; W. J. Lansley, Henry Krouse, Elizabeth; W. H. K. Davey, Elmora; capital stock, $10,000.

ALLEGHENY, PA.—Local papers state that the committee will recommend a system of filtration, the estimated cost of the new works including this being $1,850,000.

CONNELLSVILLE, PA.—The H. C. Frick Coke Co. is reported as about to construct a 2,000,000-gallon reservoir on Porter Hill, south of this place, which will supply the plants at Leisenring, the Trotter, and probably Adelaide. The pumping capacity will be 1,000,000 gallons per day.

GREENCASTLE, PA.—The Consumers Water Co. has been incorporated at this place, not at New Castle as stated last week. A gravity supply will be secured and the works will be completed as soon as possible, according to reports; Pres., F. H. Cheney, Philadelphia; Treas., John M. Moyer, Philadelphia.

OIL CITY, PA.—Extensions are needed to secure additional fire protection.

PALMYRA, PA.—The reservoir is being enlarged and efforts are being made to secure an increased supply.

PATTON, PA.—The Patton Water Co. has been incorporated; capital stock, $10,000; Treas., E. C. Brown.

WEST CHESTER, PA.—It is reported that a 1,500,000-gallon pumping engine has been purchased from the Barr Pumping Engine Co., Philadelphia, at $3,545.

ANNAPOLIS, MD.—The Annapolis Water Co. has engaged Jas. H. Harlow, Pittsburg, Pa., to examine the supply with a view to improvements.

LAUREL, MD.—W. H. Dorsey, Cy. Clk., writes us that the question of works is being agitated but that nothing can be done until the next session of the legislature, which meets in January.

PORT DEPOSIT, MD.—It is reported that a franchise has been granted to the company putting in the electric light plant, and that a reservoir will be built and works put in next summer.

PETERSBURG, VA.—Land for a new reservoir has been purchased and the construction will be pushed as rapidly as possible; estimated cost, $30,000.

ELKINS, W. VA.—Alexander Potter, New York, has submitted plans and estimates to Senator Davis and S. B. Elkins for a system of water supply. The works will be constructed by private capital as soon as spring opens. The supply will be pumped from Tyghart Valley River to a reservoir. Estimated cost, $30,000.

ELBERTON, GA.—A bill has been introduced in the legislature authorizing this city to build works and an electric light plant.

ATHENS, TENN.—The contract for pipelaying for the new works has been awarded to J. B. Dacus.

SPRINGFIELD, O.—The trustees think the purchase of a new 10,000,000-gallon pump a necessity.

YOUNGSTOWN, O.—The proposition to issue bonds, referred to Nov. 2, did not receive the necessary two-thirds vote and will now probably be postponed until the spring election.

ROCHESTER, IND.—It is reported that bonds have been sold for the construction of works.

BAD AXE, MICH.—Preparations are being made for works, according to reports.

EATON RAPIDS, MICH.—J. J. Milbourn, Clk., writes us that the proposition to issue bonds for works has been defeated, which settles the question for the present.

CENTRALIA, ILL.—We are informed by Jas. Benson, Mayor, that a contract will be let about the last of December for works, including about 10 miles of pipe, 70 hydrants, two 1,000,000-gallon compound pumps, two 30-HP. boilers and a pump house. The supply will be from Crooked Creek. Engr., Hiram Phillips, St. Louis.

CHICAGO, ILL.—Bids are asked until Dec. 4 for furnishing and laying pipe in one street. H. J. Jones, Comr. Pub. Wks.——The Seckner Contracting Co., Unity Bldg., has been awarded a contract, at about $10,000, for extensions to the water mains of the Grant Land Association. This company laid the mains for the original distribution system last spring. The main now being laid connects the works with the Chicago mains at West 48th St. and Barrie road.

GLENCOE, ILL.—John Day, Vil. Clk., writes us that as soon as the ordinance for special assessment has been confirmed by the courts he will be ready to send specifications to contractors; estimated cost of works, $85,000.

JACKSONVILLE, ILL.—The city is advertising for parties to buy or lease the works, which reports state need extensive improvements. J. W. Davis, Cy. Clk.

TRENTON, ILL.—Work will soon be commenced on the proposed works, the supply to be from artesian wells; estimated cost, $10,000.

DES MOINES, IA.—Propositions are being considered for the purchase of the works.

WILLIAMSBURG, IA.—H. E. Hull, Mayor, writes us that the contract for works has been awarded to Fairbanks, Morse & Co., Chicago, the supply to be from artesian wells; population, 1,000. Engr., G. W. Wyn, Cedar Rapids, Ia.

WINONA, MINN.—The city engineer is arranging to secure an additional supply from the wells.

AUBURN, NEB.—Works will be put in, according to reports, the work to be commenced as soon as possible.

BEATRICE, NEB.—The city engineer has been directed to report estimates for sinking additional wells.

FORT PIERRE, S. DAK.—The city council is reported to have voted to put in works.

HOT SPRINGS, S. DAK.—The contract for pipelaying has been awarded to Trout & Gillespie.

MADISON, S. DAK.—Elmer Sheridan, Cy. Aud., writes us that bids will soon be asked for works estimated to cost $30,000. The supply will be from wells and pumped to a stand-pipe; population, 3,000. Engr., W. S. Reed, Chicago.

SIOUX FALLS, S. DAK.—J. T. Cogan and D. L. McKinney are members of a committee to negotiate for the purchase of the works.

CASPER, WYO.—E. J. Carpenter, Jr., Tn. Clk., informs us that bids will be received until Dec. 15 for $30,000 of water bonds. The supply for proposed works will be from a mountain about eight miles distant; population, 700.

KANSAS CITY, MO.—J. K. Davison is secretary of a special committee appointed by the mayor to ascertain the feasibility of organizing a local company, with a capital stock of $1,000,000, to build new works.

ST. LOUIS, MO.—The contract for two 30,000,000-gallon pumping engines has been awarded to the E. P. Allis Co., at $156,000. The bids were published last week.

LITTLE ROCK, ARK.—It is reported that work has been commenced on the North Little Rock works.

BEEVILLE, TEX.—The Beeville Water Co. has awarded the contract for works to Greathouse & Taylor, at $8,000, who inform us that the material has not yet been bought. The supply will be from surface wells, and a stand-pipe and extensions will probably be added later; population, 3,500. Frank S. Taylor, Engr.

ELGIN, TEX.—John Andrewaltha, owner of the works, informs us that a contract has been awarded to W. E. D. Long, Morrillton, Ark., for piping and supplies to connect a proposed new supply from shallow wells with the present system, now supplied by an insufficient supply pumped from a deep well.

GEORGETOWN, TEX.—The Georgetown Water-Works & Electric Co. has been incorporated and purchased the works; capital stock, $100,000; Pres., W. K. Makemson; Secy. and Man., E. E. Taylor.

HEMPSTEAD, TEX.—Wm. Joseph, Cy. Secy., writes us that the city wants works but has done nothing to secure them. A company that would put in works might secure nearly any desired concession. An artesian well has been agitated but the matter has assumed no definite shape.

BARNUM, COLO.—The Colorado Iron Co. will soon lay mains, according to reports.

GLOBEVILLE, COLO.—The American Water Co. offers to furnish a supply at 5½ cts. per 1,000 gallons. Its mains pass within 500 ft. of the town and the proposition is being considered by the town board.

SOUTH DENVER, COLO.—The town board has renewed its contract with the Citizens' Water Co. for a supply. This will cost about $7,500, or one-half the estimated cost of operating its own plant, according to reports.

ALBUQUERQUE, N. MEX.—The council and the water company are at odds and municipal works are proposed.

SPOKANE, WASH.—Local papers state that the following bids were received for the proposed new works, section A including the dam and abutments, head race, tail race, headgates, steel flumes, power station and foundation; section B being for four water wheels; section C for pumping machinery, and section D for the conduit:

Section A—Bye & Cameron, $238,930; McKinzie & Glenn, $238,176; Burns & Chapman, $237,380; Hugh L. Cooper, $229,459; Ilse & A. C. Olsen, $176,668; L. J. Martin, $129,781; R. A. Jones, bid itemized, estimated at $220,000 to $230,000.

Section B—Hugh L. Cooper, $18,900; S. Morgan Smith, $15,675.

Section C (eight plans)—Hugh L. Cooper, plan A, $34,054; Knowles Steam Pump Works, plan A, $34,112; Philip Buehner (four pumps), $29,600; Dow Pump Works (four pumps), $21,484.

Section D—Hugh L. Cooper, $77,928; Burns & Chapman, $80,290.

TACOMA, WASH.—Press reports state that Col C. W. Griggs has offered to secure a daily supply of 20,000,000 gallons from the Mashell River, 35 miles south of the city, for $590,400.

COLTON, CAL.—A permanent organization has been decided upon to agitate the question of constructing works. Milo Gilbert, Pres.

OAKLAND, CAL.—Three bids have been received for a supply the prices ranging from 4½ cts., 8 cts. and 10 cts. per 1,000 gallons for a supply of 2,500,000 gallons, to 3 cts., 5½ cts. and 7 cts. for a supply of 10,000,000 gallons, the water to be delivered at eastern city limits under a pressure of 50 lbs. per sq. in.

PASADENA, CAL.—The stockholders of the North Pasadena Land & Water Co. have voted to issue bonds for $50,000 for improvements and extensions.

WINDSOR, ONT.—Bids are asked until Dec. 10 for 1,300 tons 30-in. cast iron pipe. C. J. Reid, Secy. Comrs.

IRRIGATION.

SAGUACHE, COLO.—Work will soon be commenced at this place on a storage reservoir for which the legislature appropriated $30,000. The site selected covers an area of 169 acres. About two miles of main ditch will also be built.

SANTA FE, N. MEX.—The Rio Grande Valley Irrigation Co. has been incorporated by E. J. Reed, B. T. McKeys and G. A. Anderson, of Deming; capital stock, $1,000,000. The charter calls for a canal line beginning on the Rio Grande River at White Rock Canon, west of this city, and skirting the foothills of the valley on the east side of the river and running south 150 miles. This is the second charter that has been taken out covering practically the same territory and a conflict over the right of way is expected to arise.

WILD FLOWER, CAL.—The residents of this place are reported as planning to irrigate 40,000 acres. J. J. Schlitz and J. R. Smith are interested.

SEWERS.

CONCORD, N. H.—A committee from this city inspected the sewage purification works at Worcester, Mass., last week.

ROCHESTER, N. H.—The question of an outlet sewer and sewage disposal is being considered.

BROCKTON, MASS.—The council has voted a loan of $100,000 for the work on the system next year.

HOUSATONIC, MASS.—The "Call" is advocating the construstion of a system.

MEDFORD, MASS.—The mayor has recommended an appropriation of $3,000 to secure plans for a system, and it is stated that an engineer has already been engaged and will begin work at once.

MELROSE, MASS.—Plans for a system in connection with the metropolitan sewerage system have been prepared by W. C. Stevens.

PROVIDENCE, R. I.—The "Journal" urges that steps be taken to secure sewage purification by chemical precipitation. Sewers are being built in the residence streets at the rate of 22 miles a year, and the question of sewage disposal is thought to demand immediate attention.

LONG ISLAND CITY, N. Y.—Bids are asked until Dec. 6 for sewers and appurtenances in Harris Ave., from the East River to Hunter Ave., thence in Hunter Ave. to Henry St. and in Crescent St. to Jane St. M. F. Claven, Pres. Gen. Impvt. Comn.

NEW YORK, N. Y.—Bids are asked until Dec. 5 and 8 for constructing sewers, five contracts at each date. L. F. Haffen, Comr. St. Impvts. Wards 23 and 24.

ALLEGHENY, PA.—Several main sewers will probably be built next season. Only $50,000 of the bond issue of $300,000 for sewers has been used.

HOBOKEN, N. J.—The committee has decided to recommend the construction of an outlet sewer to cost $100,000.

MILLVILLE, PA.—The council has passed a sewer ordinance which provides for the construction of a system within a year, according to press reports.

PITTSBURG, PA.—The director of public works opened bids Nov. 18 for 49 sewers to be constructed this winter. There were 475 bids and 25 bidders, contracts being awarded to the following: Evan Jones, Mr. Keeling, Ridge & Co., Samuel Gamble, Fred Ambruster, J. H. McQuade, N. D. Booth, Ott Bros., Thos. Swain, Sloan & McIlvaine, K. Bracken, R. Hillis.

CINCINNATI, O.—The board of administration will receive bids until Dec. 23 for a sewer in Crawfish Creek, with a 54-in. branch from Eastern Ave. to Woodbridge Place.

YOUNGSTOWN, O.—Bids are asked until Dec. 2 for sewers in two streets. H. W. Calvin, Clk.

PERU, IND.—A committee has been appointed to employ an engineer to prepare plans for a system.

RICHMOND, IND.—Bids are asked until Dec. 15 for 12-in. sewers in several streets. L. E. Browne, Cy. Engr.

PONTIAC, MICH.—W. G. Hinman, S. R. Cole, Elmer Webster, S. S. Matthews and C. E. Crofoot have been appointed a sewer board to have charge of the proposed sewer work.

JANESVILLE, WIS.—O. G. Bleedorn, Cy. Engr., has reported that the proposed system will cost $200,091 according to the plans prepared by Chas. F. Loweth, St. Paul, estimating the pay of laborers at $1.50 per day.

RACINE, WIS.—It is reported probable that several miles of lateral sewers will be constructed next year.

ST. LOUIS, MO.—Plans have been prepared for sewers in 10 districts. The work will cost about $90,000 and will be advertised at once so that the construction may begin early in the spring.

TEXARKANA, ARK.—Bids are asked until Dec. 15 for the construction of a system in this city and Texarkana, Tex., the contractor to furnish all material and construct and maintain the system at his own expense. H. B. Scofield, Secy. Com.

SAN ANTONIO, TEX.—The local press is advocating that the city construct a complete system.

TORONTO, ONT.—Bids are asked until Dec. 9 for a brick sewer in Montray St. David Lamb, Chn. Com.

STREETS.

BROOKLYN, N. Y.—Bids are asked until Dec. 12 for paving one street with cobblestones. John P. Adams, Comr. Cy. Wks.

JAMAICA, N. Y.—Bids are asked until Dec. 8 for macadamizing 4,000 lin. ft. of Broadway, as stated in our advertising columns. John J. McLaughlin.

ALLEGHENY, PA.—Considerable paving is being planned for next season. Of the $600,000 of bonds of repaving streets only $215,000 has been expended.

ALLENTOWN, PA.—Appropriations have been asked for paving in one street with brick or macadam and for grading in 14 streets.

NORWOOD, O.—Bids are asked until Dec. 16 for macadamizing two streets. Engr. J. M. Harper, Ninth and Plum Sts., Cincinnati.

ELECTRIC LIGHT AND POWER.

BATH, ME.—The contract for 31 arc lights for street lighting has been awarded at $95 per light per year if the lights are to burn until two o'clock, or $120 per light for lights to burn all night, moonlight schedule.

CARIBOU, ME.—Owing to an increase in the electric light business at this place and Fort Fairchild, it is stated that Albe Holmes, owner of the water power and electric light plants, will immediately make additions to the systems, including the stringing of 25 miles of wire between this place and Fort Fairfield, and the addition of an 800-light dynamo and a 200-HP. wheel to the electric light station at the dam.

LACONIA, N. H.—The committee has recommended a contract with the Laconia Electric Lighting Co. for five years, at $95 per year for each arc light for all-night lighting, or $80 for lights to burn until one o'clock. The Belknap Mills Co. had offered to put in dynamos and furnish power for street lighting, at $25 to $37.50 per light per year, the city to furnish its own wires and lamps.

CAMBRIDGE, MASS.—The committee has reported that a municipal lighting plant would save the city about $20,000 per year, but that such a plant can be secured according to law only by purchasing the plant of the Cambridge Electric Light Co.

BROOKLYN, N. Y.—The commissioner of city works will advertise this week for bids for street lighting for next year.

NEW YORK, N. Y.—The stockholders of the Edison Electric Illuminating Co. have authorized an issue of $1,750,000 of additional 5% bonds for building and developing the underground system.

AMBLER, PA.—It is reported that an election will soon be held to vote on an increase of bonds for $15,000 for a municipal plant.

CLEVELAND, O.—The board of control will receive bids until Dec. 13 for street lighting for one year, including 230 electric lights.

GREENVILLE, O.—A franchise for an electric light plant has been granted to E. Lawrence.

VIRGINIA, MINN.—The Virginia Light & Water Co. has increased its capital stock from $50,000 to $75,000.

LONDON, ONT.—An ordinance authorizing an issue of bonds for $65,000 for a municipal electric light plant has passed its first reading by the council.

NEW COMPANIES.—Electric Transmission & Mfg. Co., Jersey City, N. J.; $100,000; operate in Mexico, South America and elsewhere; J. L. Ludwig, Brooklyn; J. W. Grannis, New York; C. M. King, Jersey City.——South Jersey Electric Co., Jersey City, N. J.; $100,000; H. A. Manderville, W. H. Curtiss, F. Brewer, F. A. Wright, South Orange.——Freeland Electric Light, Heat & Power Co., Drifton, Pa.; $15,000; operate at Freeland, Pa.; Treas., Harry E. Sweeney, Drifton.——Midway Electric Light Co., St. Paul, Minn.; $30,000; Geo. B. Lynch, E. A. Forbes, G. F. Downing.——New Haven Automatic Lighting Co., New Haven, Conn.; $10,000; J. L. Williams, F. L. Wallace, L. T. Lawton.——Georgetown Water & Electric Co., Georgetown, Tex.; $100,000; planning to put in a plant; Pres., W. K. Makemson; Treas., J. W. Robertson.——Anderson Electric Light Co., Anderson, Ind.; $50,000; C. L. Henry, J. F. Wild, E. E. Hendee.——Globe Electric Light Co., Portland, Me.; $300,000.——Parsons Electric Light Co., Parsons, Kan.; $100,000.——Monett Electric Light, Power & Ice Co., Monett, Mo., $50,000.

CONTRACT PRICES.

SEWERS.—Milwaukee, Wis.—G. H. Benzenberg, Cy. Engr., has sent us a statement of the bids received Nov. 21 for the first section of the new tunnel sewer, which will cross section 25 of the town of Wauwatosa. The sewer will be 10 ft. in diameter, 2½ miles in length when completed and will probably be two years building. The contract was awarded to Geo. Mackey, at $15.65 per lin. ft. for 10-ft. brick tunnel sewer, 500 ft, and 85 cts. per lin. ft. for ditch, 700 ft., but Mr. Mackey afterward wished to withdraw his bid. The other bids were as follows, the first price being per lin. ft.. for the sewer and the second being for the ditch:

R. J. Wilson....	$27.00	$1.00	J. J. Crilley.....	$27.80	$1.40
F. B. Burness....	29.95	.90	E. Bowler	22.90	.36
David Turner...	27.00	.98	N. Forrestal.....	28.00	22.00
Thos. R. Bentley	20.88	1.20	Wm. Forrestal..	20.00	3.00
Jas. S. Brand....	22.00	2.00	N. F. Reichert ..	40.60	2.00
J. Werner........	26.00	2.00	Jas. Cape........	39.90	1.50

Reading, Pa.—The following bids were opened last week: Pennsylvania Sanitary Sewage Co., 54-in. circular brick sewer, 2,000 ft., $8.75 per lin. ft.; 5-in. pipe sewer, 70,000 ft., 70 cts.; 6-in., 87 cts.; 8-in., $1.05; 10-in., 66,000 ft., $1.22; 12-in., 28,850 ft., $1.40; 15-in., 3,775 ft., $1.95; 18-in., 6,225 ft., $2.30; 24-in., 3,450 ft., $3.45; 320 manholes, $35 each; concrete, $5.20 per cu. yd.; timber foundations, $21 per M ft. B. M.

P. Frank Hawman: $8.50, 85½ cts., 88 cts., 92 cts., 94 cts., $1.07, $1.35, $1.53, $2.07, $68, $7.50, $46, respectively.

William Grant Cook: $9, 40 cts., 50 cts., 60 cts., 75 cts., 77 cts., 90 cts., $1.68, $2.46, $50, $6, $40.

C. Robert Buschner, Philadelphia: $7.50, 98 cts., $1.13, $1.85, $2.17, $2.48, $3, $3.65, $4.40, $41, $7.30, $23.

A. H. & P. Hawman: $7, 68 cts., 95 cts., 99 cts., $1.04, $1.08, $1.50, $1.65, $2.60, $75, $9, $45.

H. E. Ahrens: $8.90, 60 cts., 65 cts., 73 cts., 81 cts., 87 cts., $1.07, $1.37, $1.90, $41, $5.50, $20.

Brooklyn, N. Y.—The following bids were opened Nov. 20 for a sewer in Eldert St.; T. J. Sheridan, 12-in. cement pipe sewer, $1.35 per lin. ft.; 15-in., $1.39; manholes, $34 each; E. Gorman, 98 cts., $1.35, $35 respectively; Harris & Maguire, 98 cts., $1.35, $34; D. J. Creem & Co., 95 cts., $1.40, $30; Harris Bogert, 91 cts., $1.25, $33.

BRICK PAVING.—Knoxville, Tenn.—A contract for 4,500 sq. yds. paving, with vitrified brick, has been awarded to John Shea, Knoxville, at $2.03 per sq. yd.

BOILER FOUNDATION.—Hancock, Mich.—The contract for the foundation for the new boiler for the water-works has been awarded to McGlynn Bros., as follows: Excavation, 25 cts. per cu. yd.; common brickwork, $15 per M; fire brickwork, $43 per M; stonework, $1.75 per perch.

BOILERS.—Philadelphia, Pa.—The following bids have been received for 24 furnace flue tubular boilers, internally fired, 8 ft. 6 ins. in diameter by 20 ft. in length:

	For 6.	For 12.	For 24.
Harlan & Hollingsworth...	$24,000	$47,745	*$95,162
Riter & Conley......................	20,875	.. .	†84,700
Southwark Foundry & Mach. Co..	27,820	55,640	....
Oil City Boiler Works..............	....	....	131,700
Edge Moor Iron Co........	....	..... .	95,760
I. P. Morris Co..........	25,740	49,750	96,390
Warden Mfg. Co........	....	....	94,880

* Exclusive of 12-in. and 18-in. pipe.

† Exclusive of 12-in. and 18-in. pipe and cast iron floor plates. The bids for four 20,000,000-gallon pumping engines were published last week.

PIPE.—Jersey City, N. J.—Geo. T. Routon, Clk. Comrs., informs us that the contract for 4 to 12-in. cast iron water pipe has been awarded at $21.50 per ton of 2,240 lbs., delivered f. o. b. cars in Jersey City.

Washington, D. C.—Bids were opened Nov. 25 for a supply of cast iron water pipe, the prices per ton of 2,240 lbs. delivered on cars being as follows:

Bidders.	12 in.	6-in.
Radford Pipe & F'dry Co., Radford, Va.	$21.06	$21.06
McNeal Pipe & F'ry Co., B'lington, N. J.	*24.00	24.00
Camden Iron Works, Camden, N. J......	†22.93	22.93
M. J. Drummond, New York....	20.70	21.50
Nat'l F'dry & Pipe W'ks, Scottdale, Pa.	21.60	21.60
Peale, Peacock & Kerr, Philadelphia	23.16	23.16
Howard-Harrison I'n Co., Bessemer, Ala.	21.40	21.40
Chattanooga Foundry & Pipe Works, Chattanooga, Tenn....	21.90	22.40
So. Pittsb'gh Pipe W'ks, Pittsburgh, Pa.	21.95	22.20

*Delivered on wharf, $22.75.

†Delivered on wharf, $21.63.

STAND-PIPES.—Philadelphia, Pa.—The following bids have been received for stand-pipes, 150 ft. high by 11 ft. in diameter, for Georges Hill and Roxboro Basin pumping stations, all but the last bid being from residents of this city: Benner & Opydyke, $22,680 for both; John Baizley, $13,220 for Georges Hill; Connery Boiler Co., $29,476 for both; Warden Mfg. Co., $20,950 for both; I. P. Morris Co., $17,490 for Roxboro Basin; Southwark Foundry & Machine Co., $23,470 for both; Riter & Conley, $21,775 for both.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

HOSE CART, ETC.—Williamsburg, Ia.—The city is in the market for hose carts, fire hose, fire bells, etc. H. E. Hull, Mayor.

WHARF.—Wakefield, Va.—Hathaway & Co., Philadelphia, have been awarded a contract for building a wharf 1,050 ft. long at this place.

TRAVELING CRANES.—St. Louis, Mo.—The board of public improvements will receive bids until Dec. 12 for two 15-ton hand traveling cranes.

SCHOOL BUILDING.—Highland, Ill.—Bids are asked until Dec. 11 for the construction of a new school building. F. S. Allen, architect, Joliet. Jos. C. Ammann.

PILES.—St. Louis, Mo.—Bids will be received at the U. S. Engineer Office until Dec. 11 for furnishing 30,000 piles, more or less, during 1894. Maj. Chas. J. Allen, U. S. A.

STREET LIGHTING.—Cleveland, O.—The board of control will receive bids until Dec. 13 for street lighting during 1894, the work including 4,100 vapor, gasoline or oil lamps.

STREET CLEANING.—Portland, Ore.—The council has instructed the committee to advertise for bids for street cleaning. It is thought that the city will save $25,000 a year by having the work done by contract.

DRAINAGE.—New Orleans, La.—The council has voted to appropriate the $700,000 to be received from the sale of the franchises of the New Orleans, City & Lake R. R. Co. for the purpose of drainage of the city.

COURT HOUSE.—Alexandria, Minn.—Bids are asked until Jan. 2 for the construction of a court house. Specifications on file in the office of Buechner & Jacobson, architects, St. Paul. Fred Von Baumbach, Co. Aud.

INDUSTRIAL NOTES.

THE BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa., have built a double-end switch engine for the Brooklyn Bridge.

THE RICHMOND LOCOMOTIVE WORKS, Richmond, Va., have an order for 20 engines for the Atchison, Topeka & Santa Fe, and also to rebuild 10 engines.

CAR SHOPS.—The new car works to be built at Memphis, Tenn., by the Litchfield Car & Machine Co., of Litchfield, Ill., as noted in our issue of Nov. 2, will be designed by Mr. J. McI. Maris, Superintendent, and will be built under the company's supervision.

STEEL WORKS.—It is announced that the Lackawanna Iron & Steel Co., Scranton, Pa., will resume work at the South Mills. The entire steel works are expected to begin work soon, and the furnacemen of the company have also been ordered to duty.

CANADIAN STEEL WORKS.—The Hamilton Iron & Steel Co. has been organized at Hamilton, Ont., with a capital stock of $1,000,000, to mine, operate blast furnaces and steel works. The city has donated a site, on which the company is preparing to build a furnace 18 × 75 ft., of the latest type, with compound cross condensing engine, hot blast stoves of the Gordon-Cowper-Whitwell patents, and other equipment for a capacity of 200 tons per day. Connellsville coke will be used, but all the ores will be from Ontario, suitable for foundry and Bessemer pig. Later on the company intends to build a steel plant in connection with the blast furnace for the manufacture of steel in all shapes for the market. Pres., Wm. Foster, Jr., New York; Vice-Pres., John H. Tildon, Hamilton, Ont.; Gen. Man. and Treas., J. J. Morehouse, New York; Secy., H. M. Curtis, New York.

THE FOSTER ENGINEERING CO., of Newark, N. J., reports great activity in its marine and railway departments. It fitted out the "Columbia" with a full supply of valves, and has an order for valves for the "Indiana." The new warships of the Brazilian navy, the "Nictheroy" and the "America," as well as the torpedo boats, have been equipped with the Foster pressure regulator.

THE LINK-BELT MACHINERY CO. has taken the contract to manufacture and sell the Caldwell water tube boiler in the West.

THE STIRLING CO., Pullman Building, Chicago, E. R. Stettinius, Treas., has a contract for a 500-HP. boiler for the Union R. R., Providence, R. I.; a 250-HP. boiler for I. H. Putnam, Rose Hill Plantation, Fla., and a 150-HP. boiler for Montgomery Brewing Co. It reports a decided improvement in business.

L. K. COMSTOCK, Monadnock Block, Chicago, has the contract for the electrical lighting system in the New York Life Bldg., Chicago, 14 stories, and the Y. M. C. A. Building, 13 stories. He has completed the installation of a lighting plant in the Columbus Memorial Bldg., which included three Edison generators and a 270-cell storage battery.

THE LEHIGH VALLEY CREOSOTING CO. has moved its offices from Jersey City, N. J., to 1 Broadway, New York, N. Y.

THE INTERNATIONAL GAS & FUEL CO., Monadnock Block, Chicago, is equipping two 80-HP. boilers with its oil burners, at the Highland Park, Ill., water-works.

THE RAND DRILL CO., New York, informs us that it has supplied to the Brazilian government the compressors for furnishing air at 3,000 lbs. pressure for the dynamite gun on the steamer "Nictheroy."

THE LAIDLAW-DUNN-GORDON CO., Cincinnati, O., informs us that it has a contract from the city of Marshalltown, Ia., for a compound condensing pumping engine of 3,000,000 gallons daily capacity, at $10,700. The city has now in use one of these engines, of 2,000,000 gallons capacity, purchased in 1890.

NEW COMPANIES.—Whitacre Air Brake Co., East St. Louis, Ill.; $500,000; William G. Whitacre, J. F. Baumgartner and Shepard Knapp. Williamson Cement Co., Chicago, Ill.; $100,000; G. A. Gary, C. P. Wagner and P. C. Kiley. Northwestern Supply & Construction Co., Chicago, Ill.; $500,000; C. C. H. Fyffe, H. T. Pebbles and H. D. Headley. C. J. Ely Car Co, Wheeling, W Va.; $300,000; Charles J. Ely, J. P. Morgan and F. J. Ball. Desplaines Construction Co., Chicago, Ill.; $100,000; E. J. Ryan, F. P. Blair and G. H. Sugrue. Conduit Construction Co., New York, N. Y.; $25,000; Thomas O. Buck, New York; Robert L. Keon, Montclair, N. J.